

ISA 58655

WATER AND WASTEWATER SECTOR ASSESSMENT IN JORDAN



WATER AND SANITATION
FOR HEALTH PROJECT

Operated by
CDM and Associates

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WASH FIELD REPORT NO. 244

OCTOBER 1988

Prepared for
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WASH Activity No. 439

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ACRONYMS

AID	(U.S.) Agency for International Development
AOMW	Division of Administration Operation, Maintenance, and Workshops
AWSA	Amman Water and Sewerage Authority
CEC	Consulting Engineer Center
DLEC	Director of Laboratories and Environmental Control
GOJ	Government of Jordan
JIPA	Jordan Institute of Public Administration
JVA	Jordan Valley Authority
KAC	King Abdullah Canal
KTR	King Talal Reservoir
MIS	Management Information System
O&M	Operations and Maintenance
RSS	Royal Scientific Society
SOP	Standard Operating Procedure(s)
TA	Technical Assistance (or assistant)
VTC	Vocational Training Corporation
WAJ	Water Authority of Jordan
WSC	Water Supply Corporation

EXECUTIVE SUMMARY

At the request of the USAID Mission in Jordan, the Water and Sanitation for Health (WASH) Project organized a four-person team to prepare an assessment of the Jordanian water and wastewater sector. The team's main focus was on municipal and industrial water supply and wastewater. The objectives of the assessment were to determine the impacts of AID's assistance and to prepare recommendations concerning AID's future role in the sector based on lessons learned from past experiences. A summary of the main points developed in the assessment is provided below.

Present Situation

The Water Authority of Jordan (WAJ), which is the principal institution in the sector, came into being in 1984. As such it is still maturing and very much in a transitional state. A revised reorganization plan became effective during the period of the assessment. This closely followed the creation of a new Ministry of Water and Irrigation, which came about in large measure as a result of AID policy dialogue.

WAJ was created by the merger of a number of entities having significantly different characteristics. The largest single entity absorbed by WAJ was the Amman Water and Sewerage Authority which was a major urban utility; at the other extreme, 165,000 subscribers in 750 villages and billing districts scattered over the entire Kingdom were incorporated into WAJ. AID's project agreements were entered into with the predecessor organizations and dealt with individual urban centers. With half or more of WAJ's subscribers now being rural in nature, AID may wish to review with WAJ its policies for the sector, especially those relating to cost recovery and pricing.

Planning for water resources development in the past has been constrained by competition between WAJ and Jordan Valley Authority (JVA) for this scarce resource. Under the proposed reorganization, whereby one agency will be responsible for water resources allocation, a more rational planning approach will be possible. Within WAJ, planning procedures have satisfied well defined criteria leading to a large capital works program which is now nearing completion. In the future, planning emphasis will shift toward optimization of existing facilities and improved operations and maintenance; these will be challenging tasks for WAJ. Under the proposed organization of the sector, it is clear that greater emphasis will be placed on financial implications of development work and their relationship with revenues and efficiency of collecting them.

The Government of Jordan (GOJ) has made remarkable progress in overcoming the scarcity of water in Jordan, and the high cost of developing water services, in parallel with the control of environmental pollution through the development of wastewater collection and treatment facilities. These efforts represent an investment level of more the 10 percent of all public investment

in the sector, higher than investments in other sectors. Substantial AID assistance was provided in implementing this program, in the form of financing capital works, training, and technology transfer. The approximate total cost of projects in which AID participated was about \$370 million, some 29 percent (\$106 million) of which represents AID's total of grants and loans. Levels of water and wastewater services in Jordan are high for a developing country: 90 percent of the urban population have access to piped water and the remainder are served by tanker; only 4 percent of the total population does not have access to the public water system; some 45 percent of the urban population and 31 percent of the total population are served by piped wastewater systems.

WAJ's financial situation is weak and apparently deteriorating. It is incurring annual operating losses, has defaulted on its debt service obligations to the central government, and has a serious liquidity problem. WAJ needs to increase its revenues by about 100 percent in order to earn a modest 6 percent rate of return on fixed assets.

Current tariffs were set in 1982 but were modified in 1986 by a 20 percent reduction in tariffs for subscriber at the lower use levels. Three different tariff schedules are in effect, one for Amman, another for the Jordan Valley, and the third covering all other areas of the kingdom. Tariffs in Amman are 60 to 75 percent higher than in the other areas, averaging about 160 fils per cubic meter (US \$1.68 per 1,000 US gallons) for a typical household. Sewer service is charged at 30 fils per cubic meter. A tariff study completed in 1986 recommended more or less unifying the tariff structures and increasing the rates so as to achieve approximately 100 percent increases in the average effective tariffs. Tariff adjustments were recommended to occur each year for five years beginning in 1987. By 1991, the average effective water tariff would have increased to 630 fils per cubic meter. Including the recommended wastewater tariff, subscribers with both water and wastewater services would have paid 1,045 fils per cubic meter (US \$10.97 per US 1,000 gallons). No action has been taken on these recommendations and the prevailing opinion in WAJ seems to be that such increases are not politically feasible.

Connections to the new sewer systems have not occurred as rapidly as originally projected, due primarily to delays in completion of the facilities. Once permission is granted to connect, there has been strong positive response with the majority of potential connections being made within a four to eight month period. There are strong incentives for households to connect, including the avoidance of cesspit emptying charges which often amount to 10 to 15 JD per month or more. There are, however, some indications that some potential new connections are deferred by the owners of multi-family units where the connection fees are high and cannot be recouped from tenants due to rent controls.

Overall performance in the revenue generating systems of WAJ is very poor, with non-revenue water estimated in the range of 52 to 59 percent. The majority of the losses are in the under-registration of meters and weaknesses in administrative systems totaling about 32 percent; leakage is estimated at 20 percent. WAJ has developed an Action Plan for reducing non-revenue water. This plan requires some refinement and improvement but is fundamentally sound in concept and approach.

Groundwater sources, which yield good quality water, provide most of the water used for domestic, commercial, and industrial purposes, excluding agriculture. Protection of water sources from pollution has a high priority and, with assistance of AID funding, has included provision of wastewater collection systems. In the future, as industrial water use increased, the monitoring and control of industrial wastewater discharges will form a vital part of measures to protect both the environment and surface groundwater sources. There are few surface water sources in the Kingdom that provide water for municipal use. The quality of surface water from one of these sources, the King Abdullah Canal (KAC), has recently been questioned in conjunction with the integrity of the AID-funded Zai Water Treatment Plan which draws water from the KAC. Review of recent research and reports on these subjects confirms that:

- ♦ Under normal operating conditions the quality of water in the KAC is acceptable as a source of raw water for the Zai facility.
- ♦ The KAC is an open canal and is therefore exposed to risk of pollution from a variety of sources ranging from intentional dumping of pollutants to accidental diversion of polluted water.
- ♦ The Zai treatment plan is complex, requiring experienced and expert staff to operate and maintain it reliably over a sustained period. It is unlikely that such staff could be attracted and retained by terms of service normally offered by WAJ. A possible solution is to privatize its operation.

Improvements need to be made in the monitoring of water and treated wastewater facilities. Although there is a proliferation of laboratories, more attention is needed to the allocation of responsibilities for monitoring and to follow-up actions in addition to establishment of appropriate standards and regulations. Water and wastewater quality monitoring is at present under study in an AID-assisted project.

Contracting for Design and Construction Services

Successful efforts on the part of AID have improved the institutional capability of public and private sector organizations, particularly the capability of Jordanian consulting engineers in project design and supervision of construction.

Design and Construction

The quality of the design and construction of facilities constructed by WAJ have for the most part been well above average and projects have been completed satisfactorily and expeditiously. Areas in which improvements may have been possible include the selection of materials, especially materials for pipes for distribution systems, water service connections and sewers. Another area which justifies further study is the appropriateness of certain water and wastewater processes, particularly their degree of complexity.

WAJ employs almost 5,000 staff to meet its many obligations in operating and maintaining a vast network of water supply and wastewater services. WAJ is also assisted by the private sector through consulting and contracting services, primarily for capital works. There are clear opportunities for private sector assistance in areas in which WAJ is perceived to lack capacity and capability, such as operation and maintenance of treatment plants and in water metering, billing, and collection of tariffs.

An area which will command more attention in the future is the re-use of treated wastewater and the related issue of treatment of industrial water. The principle of re-use of wastewater treatment plant effluent for irrigation of certain crops has been accepted in Jordan, and a number of facilities have been accepted in Jordan, and a number of facilities have been constructed for this purpose. The increasing scarcity of water and the projected growth in industry heightens the importance of monitoring and controlling industrial wastes.

The construction industry in Jordan is well structured, with adequate provision for registration and classification of engineering consultants and contractors. In WAJ, selection and contract award procedures are equitable and promptly implemented. WAJ has successfully implemented a larger program of capital works over the past decade to quality standards well above the average for developing countries. Engineering and construction capabilities have improved as a result of experience gained by technology transfer efforts by AID and other foreign donors, and by experience gained through development work throughout the region.

Impact of AID Program—Summary

AID assistance has been well balanced between investments in capital facilities and support for institutional development and training. AID capital assistance has allowed Jordan to have one of the most modern physical plant facilities in the water/wastewater sector of any country in the developing world. The technical assistance programs have had to be flexible and adaptable to changing circumstances. In addition to the training of water and wastewater systems operators and technicians which was incorporated directly in the various sector projects, AID has provided training for WAJ's managers in a variety of management subjects. The lack of skills and inexperience of staff will be a major problem for some time to come. A major institution building project initiated in July 1987 responded to urgent requirements for assistance in reorganization planning in WAJ as well as addressing some of the needs of the new Ministry. This type of technical assistance is well conceived but will need to be expanded in scope and magnitude if it is to meet both the needs of WAJ as well as the new ministry. This is an important investment decision for AID. The degree to which the new ministry is able to quickly address its many problem areas is directly dependent on how senior management organizes itself to deal with key policy issues.

AID has consistently supported the concept of financially sound water and wastewater operations, based on rational commercial practices. The tariff increase of 1982 and the subsequent increase in revenues in the sector may be attributable in part to AID's strong policy support. Throughout this period,

AID has remained sensitive to the potential needs of low-income households for financial assistance in gaining access to new systems, especially new wastewater systems. Subsequent follow-up analyses by AID have shown that the ability of low-income households to gain access to services has not been problematic.

AID lending terms have been highly beneficial to the GOJ, with long grace periods (often ten years) followed by repayment periods of 30 years. Interest has generally been set at 2 percent per year during the grace period and at 3 percent per year thereafter. These terms have not been passed through to WAJ. Generally, relending terms to WAJ have been at 8 percent interest, with a four-year grace period and 20 years for repayment. In aggregate, WAJ must pay the GOJ some US \$60 million more than the GOJ must pay to the United States during the first ten years of the various AID loans.

Lessons Learned and Policy Issues—Summary

The principal lessons of AID's experience and related policy issues are summarized as follows:

- ♦ The nature of AID's relationship with the sector is changing due to the major change in the way the sector is organized and the inclusion of a large, if not dominant, group of rural subscribers. This could affect AID's positions on such issues as cost recovery and pricing policy.
- ♦ New wastewater systems are inherently poor financial performers. An element of subsidy is required for a number of years until the revenue stream can be built-up through the connection of individual premises. The pass-through of AID lending terms from GOJ to WAJ would help alleviate current cost burdens.
- ♦ Tariff setting is best accomplished after resolution of basic cost recovery and pricing policy questions. Such questions for consideration in Jordan would include whether or not the levels of service and ability-to-pay issues should be considered in setting tariffs in rural areas that would be different from those in urban areas. Should, for example, tariffs set for rural subscribers include cost recovery elements for debt service on loans used to build facilities in urban areas? Actions aimed at the reduction of non-revenue water should also be initiated as a precedent to tariff setting.
- ♦ The new ministry will require technical assistance and advisory services to help support the full implementation of the ministerial concept. There are concerns that realization of the ministry's full potential may lag significantly without substantial advisory and technical inputs. Other institution building efforts for WAJ will have to be lengthened and expanded to meet currently identified needs.

- ♦ The GOJ's inclinations and capacities in the areas of operations and maintenance lag far behind what is required. There is a clear distinction between the very high quality and sophistication of the GOJ's physical plants and the skills and experience of its operational staff to man them. This problem is exacerbated by the fact that there are shortages of skilled, experienced staff throughout the GOJ public and private sector. The disequilibrium between demand and supply will, over the short term, prove a frustration to both GOJ and AID training programs.

Recommendations

Institutional management recommendations fall under two headings, (1) basic institution building (including privatization and O&M) and (2) support for revenue enhancement measures.

♦ Institution Building:

- provide senior consulting/advisory assistance in the approximate amount of 100 person-months to the ministry in such areas as irrigation engineering, water resources management, development economics, and public policy analysis
- lengthen and expand the CH2MHill project by approximately 60 expatriate person-months and an equal amount of local consultant time and extend the duration of the project by at least two years, to 1991
- assist WAJ in improving its planning, administrative, and technical performance by establishing an independent review committee comprising a representative from the Office of the Minister of Water and Irrigation, WAJ expert personnel, experts from RSS and the private sector to review technical proposals (master plans, feasibility studies, engineering designs, selection of equipment and materials, draft procurement contracts, etc.)
- Assist WAJ to privatize those functions which cannot be effectively managed by WAJ due to organizational and/or administrative constraints, and which would be more effectively managed by the private sector including operation and maintenance of selected water and wastewater treatment plants (including Zai, Irbid and possible others); implementation of a pilot project for management of water consumer metering, billing and collection (and source metering) initially in a discrete area.

- Assist WAJ to improve its ability to monitor and control industrial waste discharges¹ by establishing a program to review and update legislation; establish acceptable levels of physical and chemical waste parameters; identify an agency responsible for monitoring waste discharges and administering regulations; establish a scale of charges based on waste composition, strengths and quantities; establish methods and frequency of sampling; identify penalties for noncompliance.
- Assist WAJ in its ongoing program of infrastructure projects, particularly those designed 1) to provide more effective use of existing facilities and 2) to renovate existing water distribution systems to reduce leakage.
- Assist private industry to establish production facilities for frequently used products in the sector (e.g., small diameter plastic pipes) and to improve the quality of presently manufactured products (reinforced concrete sewer pipes) with a view to competing in Jordanian and foreign markets.

The estimated cost of this assistance is approximately US \$2,350,000 spread over a three-year period.

♦ Revenue Enhancement Measures:

- establishment of a Working Group on revenue enhancements of key officials of WAJ and concerned ministries to report on progress directly to the Minister
- consider funding the Action Plan for water loss reduction, as compensation for GOJ implementation of unpopular managerial and cost recovery policies
- promote a systematic approach of policy determinations and loss reduction measures as a precedent to tariff setting

¹ Part of this activity may have been included in the study "Water/Wastewater Sector Training. Water Quality Monitoring and Technical Advisory Services," by CH2MHill International, James M. Montgomery, Consulting Engineers Inc., Brown and Caldwell, Consulting Engineers.

- promote reductions in cost burdens of WAJ through such measures as improvements in efficiency; transfer of non-water/wastewater functions; and reduction in debt service by the use of pass-through financing of AID lending terms
- provide funding assistance for the development of a computer model for evaluation of optional tariff policies; approximately four person-months of expatriate and an equal amount of local consulting time would be needed
- promote the establishment of a revolving fund for financing new sewer connections on an installment plan basis; offer to provide seed money for the establishment for such a fund.

The estimated cost of such funding support in this area is US \$6,000,000 over a three-year period.

Operations and Maintenance

Extend advisory services after a facility has become fully operational. This will provide for optimization of processes and institution of cost saving procedures.

- ♦ A study should be conducted to determine if it is feasible and cost effective to use the old Ain Ghazal wastewater treatment as a hands-on training facility for the Kingdom.
- ♦ A study should be undertaken to determine if it is feasible and cost effective to operate the Zai water treatment plant by the private sector - contract operations.

An evaluation of the benefits of overseas training by WAJ personnel should be undertaken as opposed to the use of O&M specialists from the United States instructing at a facility that is operational.

A standardized management information system must be developed and implemented throughout WAJ.

A master list is needed of all training courses from the various entities, applicable to WAJ personnel. These courses should be evaluated for their uniformity.

A cadre of qualified trainers should be developed from all agencies that conduct training and they should be used as adjunct trainers at the National Training Center.

To further the growth of WAJ personnel in the water/wastewater sectors, a cadre of experienced personnel, with hands-on experience gained at operating plants, should be designated as "trouble shooters" and used to evaluate and advise on operational problems at the existing plants.

Contract Operations

Contract operations is a service that is particularly suited to treatment plants that have built expansions with sophisticated equipment or new treatment plants with recurring operating problems or finished water quality problems. Contract operations can provide improved process control expertise which could improve finished water quality and reduce operating costs.

The contract operator can implement cost identification procedures which can reduce overall costs through management improvement programs and provide a more sophisticated approach to improving plant maintenance, appearance, and reliability.

The contractor has the option based on the contract specifications of providing the supervisory staff, i.e., superintendent, maintenance manager, laboratory manager, and the client providing the operating staff; or the contractor could provide the entire staff. The first option may have more appeal to WAJ as it would allow a cadre of experienced plant and maintenance personnel to be assigned to the facility, and this would allow an upgrading of their skills. The skills of this group could be used in further training of operating personnel at other locations.

Chapter 1

INTRODUCTION

1.1 Background

Development planners in Jordan have traditionally placed major emphasis on water supply as an essential factor in support of the Kingdom's economic growth and prosperity. USAID has consistently supported GOJ's efforts in the development of its limited water resources, through a balanced program of investments in capital facilities and assistance in institutional development and training. Significant progress in the expansion and development of capital facilities has already been made and the Government's programmed investments will result in substantial achievement of its goals in the sector by the early 1990s.

In the remaining years of the 1980s and beyond, the Jordanian water sector will be entering a period of transition. In this next phase of development, the skills of its managers and the institutions within which they function will be challenged to provide consistent delivery of the expected levels of service. The sector will also be expected to function with an increasing degree of financial independence, thereby reducing the burdens placed on general government resources. Against this background, AID determined that the timing was appropriate to conduct a sector assessment as an input to decision making concerning its future role in the sector.

The concept of the water and wastewater assessment, which has been evolving for some time, was formalized during 1987. Discussions between the Asia and Near East Bureau (ANE), the AID Mission in Amman, and WASH resulted in an agreed upon scope of work late in 1987. A consulting team consisting of three specialists in the water and wastewater field was organized early in 1988. Overall direction and guidance was provided by a representative of AID's ANE Bureau. Principal emphasis in organizing the team was given to engineering, operations and maintenance, and financial/institutional expertise. After being briefed by AID and WASH staff in Washington, the team mobilized in Amman on June 1, 1988, and prepared the assessment during the following four weeks.

1.2 Scope of Work

The basic thrust of the scope of work is to determine the impact of AID's past investments in the sector, using the lessons learned from those experiences as a guide in developing a recommended agenda for AID's future participation. The assessment is focused on domestic and industrial water supply and wastewater; assessment of AID's programs in irrigation is not included in the present study. Prospective in nature, the assessment was designed to determine how AID can best utilize limited resources in strengthening both the private and public participants in the sector. The team was charged with the following specific tasks:

- (1) Provide an overview of activity status (AID, GOJ, and other donors).

- (2) Assess the impact of past investments.
- (3) Provide an inventory of lessons learned as a guide to current and future activities.
- (4) Provide recommendations on what AID should do to preserve and maximize past investments.
- (5) Discuss, as far as possible, portfolio and management implications of various levels of effort (considering contracting and joint-venture issues).
- (6) Identify policy dialogue issues for various levels of AID investment.

Additional areas to be considered include technology transfer and sustainability as related to operation and maintenance systems, tariff structures, privatization, and wastewater re-use.

Chapter 2

THE JORDANIAN WATER SECTOR - AN OVERVIEW

This chapter presents, in capsule form, an overview of the present situation in the Jordanian water sector. The principal areas of interest are covered under two headings, one dealing with the institutional development and functional make-up of the Water Authority of Jordan (WAJ) which is the principal institution serving the municipal and industrial needs of the Kingdom. The other major subheading in the chapter provides a description of the present situation pertaining to revenue generation, dealing with both the technical features of the systems (e.g., meter performance and network leakage) and the "soft" elements such as billing and collection procedures, supervision, control, and human resources.

2.1 The Institutional Development of WAJ

2.1.1 Organization and Management

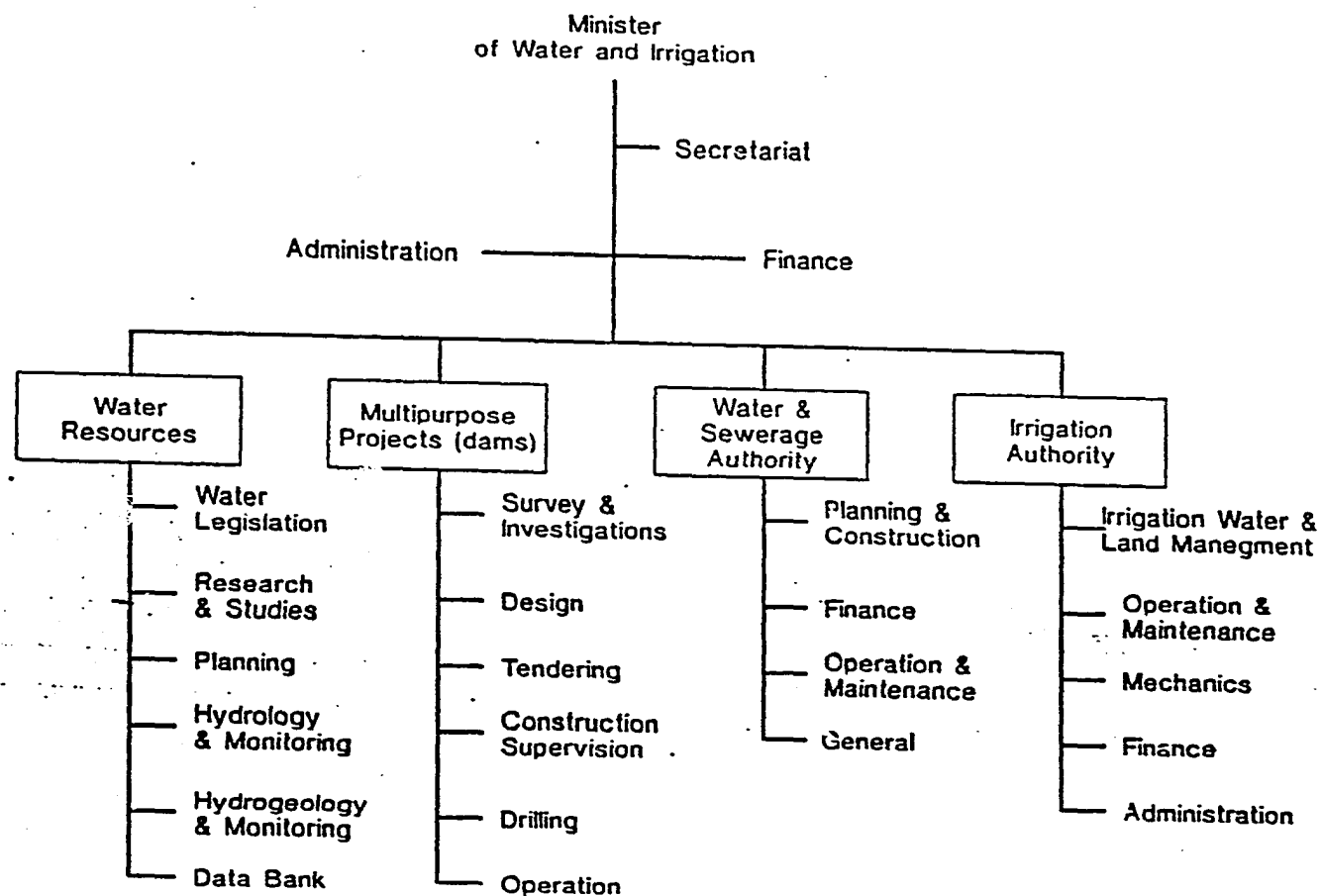
Prior to 1984, the water sector in Jordan was geographically and functionally fragmented, with responsibilities for municipal and industrial water supply and wastewater assigned to a variety of government and semi-autonomous agencies. A major step toward the rationalization of institutional responsibilities in the sector, long a subject of policy dialogue between AID and the GOJ, was taken in 1983 with the establishment of WAJ. WAJ was created through the merger of the Amman Water and Sewerage Authority (AWSA), the Water Supply Corporation (WSC), the Water Directorate of the Natural Resources Authority, various Water Districts under the Ministry of Municipalities, and the Water Supply Projects Department of the Jordan Valley Authority (JVA). The merger of these entities came into effect in January 1984. Although the reorganization represented a step forward, the organizational arrangements within WAJ were far from optimal with, for example, some 22 departments reporting directly to the President.

Further steps toward rationalization of the sector have been undertaken in 1988 with the establishment of a Ministry of Irrigation and Water, incorporating WAJ and JVA under a single ministry. Reallocation (to two new departments in the ministry), of certain functions now incorporated within WAJ and JVA dealing with water resources management and multi-purpose projects has been under consideration. However, no definitive steps toward implementation of the proposed ministerial organization, shown in Figure 1, had been taken at the time of preparation of the sector assessment. Supporting staff arrangements at the ministerial level were being developed at the time of the assessment.

Far from being a static institution, WAJ has recently (effective June 1, 1988) adopted a revised internal organization plan greatly reducing the span of control of the Secretary General and clearly delineating the functional responsibilities between headquarters and decentralized units to be operated

Figure 1

JORDAN **Water Sector Organization** **Proposed Structure**



Source: The World Bank, Jordan Water Resources Study
 Annex 6.3, March 18, 1988

in each Governorate in the Kingdom. Of the five major administrative subdivisions in the new WAJ headquarters organization, one (Water Resources) appears to have been structured so as to be readily transferable to the JVA and the two new departments being considered for creation within the ministry.

Organization charts for WAJ's new headquarters and governorate level organizations are presented in Figures 2 and 3. These arrangements are in the process of receiving further detailed definition and implementation with technical assistance provided by consultants through the AID-sponsored Water Systems and Services Management Project. Consultants provided under this project are also assisting in the preparation of the ministerial-level organization and staffing arrangements as noted above. It is expected that full implementation of the new organizational plan including any necessary reassignments of WAJ's 4,644 employees and permanent appointments to all supervisory positions will be undertaken during the remainder of 1988.

It is intended that WAJ, an autonomous public department, should function as an independent public utility or enterprise. However, WAJ remains partially dependent upon general government financial support and prepares its budget requests in the same manner as other government departments. Although WAJ maintains its own bank accounts and deposits all revenues and subsidies therein, the government's system of expenditure controls must be observed.

Financial accounting and reporting are in accordance with government prescribed formats, and standard government purchasing and contracting regulations must be followed. WAJ employees are subject to the standard government personnel system in all respects, except that an increment of one-third of base salary is allowed in recognition of WAJ's work day which is 1.5 hours longer than other government agencies. For all practical purposes, WAJ operates within the same parameters as any other government organization.

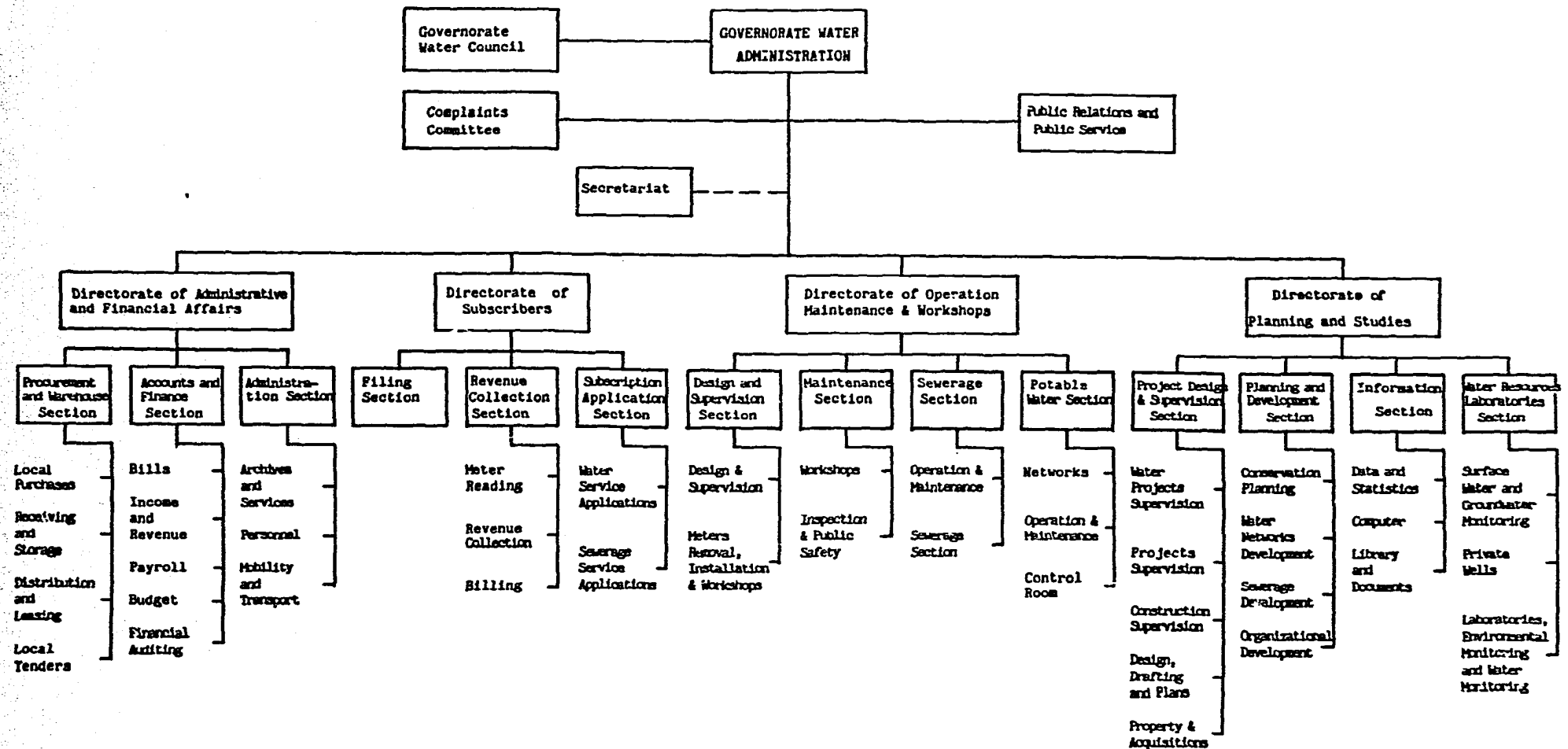
2.1.2 Clientele and Service Area

The WAJ service area is Kingdom-wide in scope, reaching remote villages as well as the urban centers. By mid-1986 WAJ was serving an estimated 358,318 water subscribers and about 76,000 wastewater subscribers, the latter being mostly in Amman. Under the new organization plan, WAJ will strengthen its decentralized operations under a senior administrator in each governorate. Although variations are likely to occur among the governorates, the prototypical organization plan as shown in Figure 3 would provide for a significant increase in decentralization, particularly in such areas as revenue systems, planning, procurement, and supply management.

Outside of Amman, WAJ's service areas may be characterized as consisting of a few medium to small urban centers and a large number of villages scattered over a wide territory. Excluding Amman, the other 13 urban centers average about 7,200 water subscribers; there are also 165,000 water subscribers scattered among some 750 villages and billing districts, each averaging only 220 subscribers. As one might expect, the Amman Governorate is the largest with nearly 160,000 water subscribers; the smallest is Tafila with only 6,400 subscribers.

FIGURE 3

ORGANIZATION OF A
GOVERNORATE WATER ADMINISTRATION
(REVISED APRIL 1988)



A tabulation of WAJ service areas showing population and subscriber data is shown in Table 1. From this it is clear that WAJ's service area and clientele fall into two distinct groups. One is the Amman urban area and environs including Zarqa. The remaining clientele of WAJ which in fact constitute the majority of its subscribers, live in a few small cities and towns and in the numerous villages spread throughout the Kingdom.

2.1.3 Construction

The major part of the construction work in the sector is designed, supervised, and managed by engineering consultants selected and appointed by WAJ engineering staff. The selection and contract award procedures are effective and projects are well managed and administered by WAJ. Over the years, compared with similar organizations in most other developing countries, the Water Authority has developed a reputation for prompt and effective implementation of development projects. The development program in the water and wastewater sector has also been larger than the average for most developing countries, amounting to between 10 and 15 percent of total public investment in the last two plan periods (1981-85 and 1988-90).

The construction industry in the Kingdom is equally well structured. All contractors are registered with the Ministry of Public Works (MPW) and are classified according to their sector of expertise (e.g., roads, buildings, water supply, etc.) and capacity in terms of the range of value of the works that each contractor has capacity to undertake. These rankings are based on the firms' asset value, staff employed, plant and equipment availability, and experience.

For contracts controlled by WAJ, invitations for bids are advertised in the local press, after decision by a Central Committee of the MPW on prequalification requirements, the classification of eligible contractors and the bid period. Bids are opened in public by MPW Central Tenders Department and are referred to a technical committee for examination and recommendations to the Central Committee of MPW for a final award decision. The procedure works well and is completed within an average time of two months.

WAJ has some 216 engineers on its staff, and 75 of whom are engaged full time in construction supervision. Although these engineers are well qualified in this respect, most financing agencies insist on employing consultants to supervise construction. The standard of construction work in the sector is well above that of most developing countries and has improved under the influence of foreign firms over the past ten years. Improvements have also resulted from experience gained through Jordanian artisans' and engineers' experience with foreign contractors in the Gulf countries. Regarding Jordanian consultants, WAJ engineers estimate that there are now 15 to 20 firms of consultants with experience in the water and wastewater sector. These firms are registered with and classified by the Engineering Association of Jordan.

In summary, construction work in Jordan is generally carried out expeditiously and effectively and the quality of the finished product is excellent.

Table 1

Tabulation of WAJ Service Area Populations and Water Subscribers

<u>Governorate⁽¹⁾</u>	<u>Service Areas⁽²⁾</u>	<u>1985 Population</u>	<u>1986 No. of Subscribers</u>
Amman	Amman City	812,513	99,831
	Villages (43)	207,137	32,939
	Billing Districts(44)	44,980	15,166
	Madaba Town	34,911	3,900
	Villages (79)	55,279	6,280
	Billing Districts(51)	<u>103,896</u>	<u>1,558</u>
Total Amman		1,258,716	159,674
Irbid	Irbid City	143,042	19,650
	Villages (94)	221,394	30,490
	Billing Dists (5)	21,206	1,486
	Ajloun Town	5,464	935
	Villages (21)	52,949	6,699
	Billing Dists (2)	8,736	24
	Jerash Town	12,266	2,688
	Villages (22)	53,032	5,517
	Billing Dists (8)	11,525	516
	Ramtha Town	33,350	4,113
	Villages (5)	<u>17,780</u>	<u>2,235</u>
Total Irbid		580,744	74,353

<u>Governorate⁽¹⁾</u>	<u>Service Areas⁽²⁾</u>	<u>1985 Population</u>	<u>1986 No. of Subscribers</u>
Balqa	M'addy Town	2,034	496
	Villages (23)	54,322	7,961
	Billing Dists (17)	49,701	2,959
	Salt Town	40,847	5,617
	Villages (18)	12,572	2,254
	Billing Dists (9)	<u>11,023</u>	<u>523</u>
Total Balqa		170,499	19,810
Ma'an	Ma'an Town	13,474	4,046
	Villages (40)	28,208	4,793
	Billing Dists (9)	5,361	646
	Aqaba Town	46,350	8,823
	Villages (2)	3,617	827
	Billing Dists (0)	<u>7,140</u>	<u>-</u>
Total Ma'an		104,150	19,135
Karak	Karak Town	14,425	3,078
	Villages (75)	72,892	10,843
	Billing Dists (17)	<u>16,998</u>	<u>1,147</u>
Total Karak		104,315	15,068
Ma'raq	Ma'raq Town	25,707	3,773
	Villages (108)	62,614	9,905
	Billing Dists. (25)	<u>93,458</u>	<u>1,233</u>
Total Ma'raq		181,779	14,911

<u>Governorate⁽¹⁾</u>	<u>Service Areas⁽²⁾</u>	<u>1985 Population</u>	<u>1986 No. of Subscribers</u>
Tafileh	Tafileh Town	14,917	2,154
	Villages (19)	16,925	3,157
	Billing Dists. (7)	<u>37,371</u>	<u>1,067</u>
Total Tafileh		69,213	6,378
Zarqa	Zarqa Town	274,972	34,210
	Villages (8)	83,018	14,599
	(incl. Ruseifa)		
	Billing Dists (1)	<u>66,924</u>	<u>180</u>
		424,924	48,989
Kingdom Totals	Cities/Towns (14)	1,474,272	193,314
	Villages (557)	941,739	138,499
	Billing Dists.(195)	<u>478,329</u>	<u>26,505</u>
Total Kingdom		2,894,340	358,318
Kingdom (less Amman City)	Cities/Towns (13)	661,759	93,483
	Villages (557)	941,739	138,499
	Billing Dists.(195)	<u>478,329</u>	<u>26,505</u>
Total excl. Amman City	2,081,827	258,487	

Source: Black and Veatch International, Consulting Engineering Center and Arab Management Services, A Study For Establishing Water and Wastewater Tariff Systems in Jordan, Vol III Appendix A, Draft Final Report, February 1987.

Notes: (1) Designated by WAJ for decentralized administration

(2) Cities and towns shown separately for some of the governorates are suggested for designation as cost centers by Black and Veatch and its associates in the Tariff Study.

2.1.4 Operations and Maintenance

The critical operations and maintenance activities (O&M) are the responsibility of a division entitled the Administration Operation, Maintenance and Workshops (AOMW). AOMW is responsible for setting policies for the central Water Resources Administration and for providing support services, including a standardized maintenance program, for all the governorates throughout Jordan.

As outlined in Figure 2, the two directorates charged with the implementation of policies and providing for support services (both central and locally) are the Directorate of Central Operations and the Directorate of Maintenance and Workshops.

The Directorate of Central Operations is responsible for operating water resources and networks serving the Kingdom, including operational control of sewerage works, and responses to water shortage problems.

The Directorate of Maintenance and Workshops is responsible for the maintenance of all water and wastewater resources equipment serving the Kingdom. It is also responsible for preparing and implementing a preventative maintenance and repair program for all equipment. The Directorate of Maintenance and Workshops has an existing preventative maintenance card system that lists all equipment and repairs to equipment and oil changes to vehicles of WAJ, tire repairs and spare parts use, etc. This preventative maintenance program needs to be computerized for more efficient operation and cost accounting.

Subordinate to the Directorate of Maintenance and Workshops is the Governorate Water Administration (local). It is charged with carrying out the local operations and maintenance requirements of the following sections:

- ♦ The Potable Water Section consists of a connections branch, a water networks branch, and the operations branch which includes pumping stations, well operations, and water treatment plant operation.
- ♦ The Sewerage Section consists of a connections branch, a sewerage systems branch including sewer maintenance and the operations branch which includes pumping stations, treatment plants, and septage haulers.
- ♦ The Maintenance Sections consist of the workshop branch overseeing pump and equipment maintenance, and the inspection and safety branch which includes inspection and public safety.

WAJ personnel are responsible for a range of wastewater treatment processes. These processes range from operating stabilization ponds (Al Samra and Aqaba), a relatively basic procedure, to primary and secondary treatment (Irbid) utilizing activated sludge and anaerobic sludge digestion, a relatively complicated process. Even more complex water treatment at the Zai plant consists of mixing/flocculation, sedimentation, filtration, and chemical

treatment including chlorination of the finished water. This process is governed by laboratory analysis and instrumentation readings and recordings. Keeping the system on line and maintaining reliability, with its instrumentation loops, associated meters, and recorders is extremely labor intensive. An additional complicating problem is a lack of spare parts for critical instruments.

To make the water treatment plant more efficient (both operationally and cost effectively) an optimization study of the process should be conducted. This study should look at the sampling program, internally and externally, application points and dosage rates of the various chemicals, length and duration of backwashing the filters, sludge consistency, and frequency of withdrawal from the sedimentation units, etc. This study should be highly focused on "fine tuning" each process unit for maximum efficiency.

Additionally, the Irbid wastewater treatment plant staff will need considerably more start up and process control training when the anaerobic digester is placed in operation, and standard operating procedures (SOPs) must be developed for this process.

Water quality monitoring needs to be standardized between all laboratories. This point cannot be overemphasized. This should include at a minimum sampling techniques, analytical procedures and frequency of sampling. This data must be made available to all levels of WAJ and input/feedback exchanged among all levels. Illustrative of the current need for external cross reference is the fact that WAJ has a contract with the Royal Scientific Society to monitor the effluent of the Al Samra plant and the Wadi it discharges to.

A study should be conducted of the Ain Ghazal Wastewater plant to determine the operability and cost effectiveness of the plant in terms of future needs as well as the possible use of the equipment at the plant as spares for other plants. The present condition of the equipment shows lack of "moth balling" at the time the plant was taken out of service which reinforces the need for SOPs to govern all phases of the sector.

A cadre of experienced operating personnel, those who were in responsible positions and gained hands on experience during the operation of the Ain Ghazal facility, should be re-assembled and assigned, as roving trouble shooters, to provide the much needed assistance in process and operational controls.

2.1.5 Training

The Directorate of Organizational Development, under the new organization of WAJ (see Figure 2), has the responsibility for the training of personnel in the water/wastewater field.

Training needs are identified through questionnaires that are sent to various directorates to determine what types of training are required. The Organization and Methods Section sets the objectives of the training program and the Training Section will develop the courses and schedule the dates for the programs.

Additional attention needs to be paid to insure that the basic objectives are clear and concise and based upon actual tasks to be accomplished.

The instructors for the courses are provided by the Training Section, with additional instructors with selected expertise from other agencies. The formal training programs are given at the Ain Ghazal Training Center, with some "hands-on training" given at a WAJ workshop. Typical training courses are water pump O&M, water/sewerage treatment plant O&M, safety and first aid, and water meter installation and maintenance. These courses range in length from 6 days to 5 months. The personnel department keeps records of the employees who have completed these courses. (Appendix A, exhibits 1 and 2 are examples of a typical training course.)

Additional training courses in several sectors are provided by the following organizations:

- ♦ Vocational Training Corporation (VTC) is primarily involved in programs for craftsman and skilled labor, such as apprentice training programs and upgrading of skills. VTC has several institutes which offer specialized training. For example, the Occupational Safety and Health Institute provides for identifying and implementing procedures to reduce industrial accidents. This institute has provided training for WAJ personnel on occupational health and safety. This type of training should be given more frequently, especially for personnel in the water/wastewater and maintenance sections.
- ♦ The Instructor and Supervisory Training Institute is another section under the VTC which has provided training for WAJ personnel in basic principles and techniques of supervision and training for instructors. These types of courses are especially appropriate for mid-level supervisors and trainers from the training center.
- ♦ The Jordan Institute of Public Administration provides general management and administrative courses in accounting procedures, office management and records filing. JIPA also offers consulting services to both the private and government sectors. JIPA is an ideal place for mid-level and upper-level supervisory personnel to upgrade their skills levels.
- ♦ The Jordan Institute of Management has provided training courses for WAJ personnel ranging from construction management to warehousing and purchasing. These courses are directed toward mid-level supervisory personnel of WAJ.

- ♦ Amman Polytechnic offers two and three year courses for technicians in engineering, drafting, training of technicians as teachers, and water treatment technology. These courses should have special appeal for WAJ personnel because, in addition to upgrading technical skills, they increase employees' possibilities for promotion.

While the array of course offerings is impressive, to be really effective, a greater coordination of the courses and training facilities from and within the various agencies must be accomplished. It is crucial that a master list of training courses which are applicable to WAJ personnel be generated and evaluated. It would be most logical and efficient, once appropriate training courses are identified, to incorporate them as a curriculum under the aegis of the National Training Center.

2.1.6 Finance

It is difficult to gain a clear picture of the financial situation in WAJ. Financial reports based on standard utility accounting formats have not been prepared by WAJ. Its outside auditors, however, have attempted to construct basic financial statements, although they too are clearly handicapped in that effort. Audit reports are available for the first three years of WAJ's existence, 1984, 1985, and 1986 and with some qualifications they provide a general indication of WAJ finances.

- ♦ Results of Operations - By the end of 1986, WAJ had accumulated operating deficits of JD 26.3 million, JD 6.2 million of which was inherited from predecessor organizations. The deficit for 1986 was JD 12.3 million, approximately double the loss for 1985. The average value of WAJ's net fixed assets in service during 1986 was approximately JD 183 million. In order for WAJ to have earned a modest return on net fixed assets of say 6 percent before interest, its revenues would have to have been JD 19 million greater, or nearly double the amount achieved. With interest on loans for work in progress being capitalized (work in progress was nearly JD 80 million at year end), interest expenses (and thus net losses) can be expected to increase significantly in the near term.
- ♦ Liquidity - Current liabilities exceed current assets by about JD 14.0 million; the current ratio is roughly 1/2. Current liabilities make no provision for long-term debt due within one year, which means that the actual situation is worse than indicated. An amount of JD 7.7 million is shown for overdue amounts of principal and interest on long-term loans. Current

assets include JD 4.7 million in receivables from subscribers with virtually no provision for uncollectable accounts. On the surface, the actual amount would seem acceptable given WAJ's quarterly billing cycle. Since the figure likely excludes accrued receivables, given the commonly held view that overdue accounts are significantly higher than normally expected, it is not realistic to assume that all receivables can be collected.

- ♦ Debt/Equity - The audit report shows total long-term debt at JD 103.1 million against a total debt plus equity of JD 243.0 million, a ratio of 42/58. Total outstanding debt at the same date was calculated to be substantially higher (JD 154.4 million) by Black and Veatch International and Associates in the Tariff Study completed in 1987 (the Tariff Study). Using Black and Veatch data, the debt-equity ratio would become 52/48. It should be noted that a significant portion of the capital transferred from various agencies is based on a valuation prepared in 1986, which should result in asset values being reasonably close to replacement costs.

Overall, the financial situation in WAJ is very weak and the report for 1987, when issued, is likely to show further deterioration.

AID under the aegis of the comptroller, may want to assist WAJ in establishing a financial management system.

2.1.7 Planning

Planning of water resources development in the past has been to some extent constrained by competition between WAJ and JVA over this scarce and valuable resource. Under the new organization, whereby the allocation of water resources is the responsibility of one agency, a more integrated planning approach will be possible. Priorities in allocating water resources are now to meet municipal demands for potable water and then to meet the demands for industrial water. Water resource allocations for further agricultural production would appear to have a lower priority in view of the overall water scarcity. Priorities for investments would also place facilities for re-use of wastewater at a high level.

Within WAJ, planning procedures historically have followed well defined criteria:

- ♦ to bring water to centers of dense urban population.
- ♦ to protect groundwater and surface waters from pollutants by providing wastewater collection and treatment systems.

to protect the environment and health by giving priority to piped wastewater systems for densely populated areas where individual forms of sanitation are not satisfactory.

Now that about 90 percent of the population has piped water the emphasis has shifted to give priority to (1) improvement of operation and maintenance procedures and training, and (2) optimization of existing facilities.

Following these criteria, WAJ formulated five-year plan proposals for submission to the Ministry of Planning. After detailed discussions of these proposals, the Ministry of Planning approval has normally been given for an investment program of about 10 percent of total public investment, a higher value than in any other sector. Clearly, the impressive and difficult task of planning and constructing many facilities for water supply and wastewater disposal has now been largely, and successfully, completed. The question remains as to whether in the planning process more and earlier emphasis could have been given to preparing to operate and maintain the facilities, or whether this could only be addressed at a later stage. In any event the planning focus is now on operation and maintenance, and WAJ faces what may be an even more challenging task under the new organization. In this connection it seems clear that greater emphasis will be placed on the financial implications of development plans with a resulting closer link to revenues and efficiency of collections.

2.2 Revenue Systems

The systems through which WAJ derives its income are reviewed in this section. This entire subject area was being given intense scrutiny in WAJ at the time of the assessment and is therefore highlighted in this section.

2.2.1 Water Tariffs

The tariff schedule currently in effect in WAJ is presented in Table 2. These tariffs were established in 1982 and modified in 1986 by a 20 percent reduction in rates charged in the first two billing blocks. Charges to several special customer categories were also reduced by 20 percent. As of 1987, billings for the subscribers in the South area were converted to quarterly billing, thus eliminating bi-monthly billing from the system.

As shown in the schedule, three separate basic sub-schedules are in effect, one covering Amman, one covering the Jordan Valley and the third covering Amman suburbs and the remaining areas of Jordan. In addition, several special rate schedules are established for tanker service, water delivered at public taps and other outlets, irrigation usage, and specific individual commercial/institutional subscribers.

Table 2

EXISTING WATER TARIFFS

Quarterly Issued Bills	Charge Per Cubic Meter
	JD
Amman	
First 20 Cubic Meters	0.120
Next 20 Cubic Meters	0.200
Next 60 Cubic Meters	0.400
Over 100 Cubic Meters	0.500
Meter Charge, Per Quarter	0.225
Minimum Bill	1.200
Amman Suburbs, and North Cities & Villages	
First 15 Cubic Meters	0.080
Next 30 Cubic Meters	0.096
Next 30 Cubic Meters	0.300
Over 75 Cubic Meters	0.400
Meter Charge, Per Quarter	0.225
Minimum Bill	1.200
Jordan Valley	
All Usage	0.100
Meter Charge, Per Quarter	None
Minimum Bill	None
Bi-Monthly Issued Bills	
South Cities, Aqaba, Zarqa	
First 10 Cubic Meters	0.080
Next 20 Cubic Meters	0.096
Next 20 Cubic Meters	0.300
Over 50 Cubic Meters	0.400
Meter Charge, Per Two Months	0.150
Minimum Bill	0.800

Table 2

EXISTING WATER TARIFFS

Special Billings	In Amman	Outside Amman
-----	-----	-----
	JD	JD
Tanker Service		
Tanker Capacity - 5 Cubic Meters	2.500	3.000
- 8 Cubic Meters	3.000	4.000
- 12 Cubic Meters	4.500	5.500
		Charge
		Per
		Cubic Meter

		JD
Water Delivered at Outlets		
General Citizens		0.200
Army, Airforce, Public Force, and Civil Defense		
Outside Amman		0.160
Inside Amman		0.350
Well No. 18 in Dail (Irrigation)		0.032
Ministry of Agriculture, Irrigation Purposes		0.010
Fertilizer Company in Aqaba		0.240
Hussein Medical Center		0.350
Electric Generating Station at Aqaba		(a)

(a) Standard rate less 20 percent.

Source: Black & Veatch International, In Association with Consulting Engineering Center, Arab Management Services, A Study For Establishing Water and Wastewater Tariff Systems in Jordan, Table 3.12.1, July 1987.

Assuming that the first two billing blocks represent a typical residential consumer's quarterly usage, charges for domestic use in Amman are approximately 60 percent higher than in the Jordan Valley and 75 percent higher than elsewhere in the Kingdom. The charges in Amman for this level of consumption, averaging 160 fils per cubic meter (US \$1.68 per 1,000 US gallons), are relatively high among developing countries. Those charges at 90 or 100 fils per cubic meter might be closer to a typical tariff for a developing country (in very general terms).

The progressive nature of the tariff schedules provides for a degree of cross-subsidization for subscribers with lower monthly usage compared with those in the higher consumption ranges, say above 40 or 45 cubic meters per quarter. Although there are no specific tariff provisions for commercial, institutional, and industrial subscribers, the progressive block rate charges should achieve substantial cross-subsidization among various types of subscribers on the assumption that non-domestic consumption quantities will generally reach the higher consumption blocks.

The Tariff Study, completed in 1987 by Black and Veatch International and Associates and sponsored by AID under the Zarqa-Ruseifa Project, provides a recommended approach for tariff adjustments. As under the existing plan, three separate sub-schedules would be established for Amman, Jordan Valley and the remaining areas of the Kingdom. For practical purposes, the three proposed sub-schedules are the same, although some small variations would exist in the higher consumption blocks. The water bills for typical residential subscribers would be approximately the same in each of the three areas. Separate charges would be made for tanker services and for water provided at outlets, but all other special rates would be eliminated. Tariff adjustments would be phased-in gradually over a five-year period beginning in 1987.

Under the proposed tariffs, the average effective charge would increase from 250 fils per cubic meter in 1986 to 500 fils per cubic meter in 1987, increasing annually to 630 fils per cubic meter in 1991. At the time of preparation of the assessment, WAJ had taken no action toward implementation of revised tariffs. The general feeling among financial staff at WAJ is that the tariffs proposed in the Tariff Study are unrealistically high. The fact that WAJ took action to reduce water tariffs significantly at the same time that consultants were recommending a 100 percent increase is indicative of the difficulty that can be expected in implementing a tariff increase of any magnitude.

2.2.2 Sources of Revenue for Wastewater Services

For some 72,000 subscribers in Amman and a growing number elsewhere in the Kingdom, the quarterly water bill includes a surcharge for wastewater services. At the present time, this amounts to a uniform 30 fils per cubic meter of water consumed (about US \$0.32 per 1,000 US gallons). In addition, property owners throughout the Kingdom are subject to a sewer tax administered by the Ministry of Finance. This tax is calculated as 3 percent of the estimated annual rental value of the property and is assessed on all properties regardless of whether they are connected to a wastewater system or

not. For a property with an assessed rental value of 100 JD per month and a quarterly water consumption of 45 cubic meters, the tax would be equivalent to 200 fils per cubic meter. The law provides that this tax will be levied on each property (building) for a period of 20 years and then discontinued, but the assumption within WAJ is that it will be made a permanent tax. Revenues from this tax are considered operating revenues by WAJ's auditors. However, the fact that the tax is unrelated to the provision of a service might lead one to believe that it is more appropriately considered a general contribution to support construction of wastewater systems.

The Tariff Study also deals with wastewater charges and recommends major increases above the current 30 fil per cubic meter charge. Like the proposed water tariff adjustments, the sewer use fees would be phased-in over a five-year period beginning in 1987. The tariffs would increase from the 30 fil level in 1986 to an average effective tariff of 115 fils in 1987 increasing rapidly and leveling off at about 415 fils in 1990 and 1991. Under the Black and Veatch proposals, the total projected water and wastewater charges based on water consumption would be 615 fils per cubic meter in 1987 increasing to 1,045 fils per cubic meter in 1991. These figures equate to US \$6.46 and US \$10.97 per 1,000 US gallons respectively. The recommended tariffs for 1991 for both water and wastewater are shown in Table 3.

2.2.3 Connection Procedures

New connections for water service are made at a flat rate of 50 JD. Connection fees had been 10 JD in the Jordan Valley and 35 JD in all other areas. The fees are uniform regardless of size of the connection/meter. The Tariff Study proposed that fees for the smallest connections sizes (20 and 25 mm) be established at 58 and 65 JD respectively and that the fees for all larger connections be based on specific estimated costs for each proposed connection.

In areas where sewerage systems are being developed, announcements are made in the newspapers on three consecutive days listing each property that may be connected and indicating that such properties must be connected. Instructions concerning connection procedures are also provided. In general, these are the standard connection procedures:

- ♦ The subscriber contacts the local office of the Ministry of Finance to determine/confirm the assessed rental value of the property to be connected.
- ♦ The subscriber makes application for connection at the local WAJ office and pays the required fees. The fees to be paid include an application fee which ranges from 3 to 10 JD depending upon the classification of the neighborhood. A connection fee of 25 percent of the assessed annual rental value of the property is also charged. For a property with an estimated rental value of 100 JD per month, the connection fee would amount to 300 JD.

Table 3

RECOMMENDED WATER AND WASTEWATER TARIFFS

1991 Test Year

	Water Utility	Wastewater Utility	Combined Utilities
	JD	JD	JD
Greater Amman			
Service Charge - Per Quarterly Bill	1.400	1.500	2.900
Volume Charge - Per Cubic Meter (a)			
First 15 cubic meters	0.200	0.150	0.350
Next 45 cubic meters	0.660	0.375	1.035
Next 240 cubic meters	0.800	0.375	1.175
Over 300 cubic meters	0.850	0.375	1.225
Outside Amman			
Service Charge - Per Quarterly Bill	1.400	1.700	3.100
Volume Charge - Per Cubic Meter (a)			
First 15 cubic meters	0.200	0.170	0.370
Next 45 cubic meters	0.620	0.695	1.315
Next 240 cubic meters	0.770	0.695	1.465
Over 300 cubic meters	0.840	0.695	1.535
Jordan Valley			
Service Charge - Per Quarterly Bill	1.400	NA	1.400
Volume Charge - Per Cubic Meter (a)			
First 15 cubic meters	0.200	NA	0.200
Next 45 cubic meters	0.590	NA	0.590
Next 240 cubic meters	0.700	NA	0.700
Over 300 cubic meters	0.780	NA	0.780

(a) Per cubic meter of measured or estimated water use per quarterly billing period. Assumes no deferral in billing and no special tariffs.

Source: Black & Veatch International, In Association with Consulting Engineering Center & Arab Management Services, A Study For Establishing Water and Wastewater Tariff Systems in Jordan, Table 0.2.1, July 1987

- ♦ WAJ processes the application, generally within 2 to 3 days, preparing sketches of the location and layout of the connection and providing for appropriate registration of the connection for billing purposes.
- ♦ The subscriber makes arrangements with a private contractor from a list of approved firms, to complete the connection. WAJ provides inspection services to assure compliance with established standards.

New subscriptions for wastewater service appear to be achieved within a reasonable period of time. In Irbid for example, about 500 (out of a total potential of 710) connections were completed in the first sewered area within five months of the published announcement, and have continued to be made at a steady but slower pace. In Karak, 200 applications were received and 85 connections made within the first month following the announcement. Strong incentives for connection exist for many households which must presently pay for cesspit pumping and removal. Monthly costs for cesspit pumping are said to range from 10 to 15 JD. For those that are slow to connect, one reason given is the high cost of connection fees (e.g., apartment buildings) and the local WAJ offices' inability to offer an installment payment plan.

2.2.4 Meter Reading, Billing, and Collecting

WAJ's revenue systems are a combination of decentralized and centralized operations. It is understood that all meter reading lists, bills, and accounts receivable records are now prepared and managed centrally through a computerized system operated in Amman. This represents a significant improvement in the various revenue processes inherited by WAJ from its predecessor organizations. However, serious deficiencies remain in the system which WAJ intends to address in the near future as part of an "Action Plan" (completed by WAJ staff in June 1988) to reduce unaccounted for water. A list of activities and estimated costs is shown in Table 4.

The revenue processes are administered primarily through area clerks in the various decentralized subscribers sections. Clerks are responsible for 3 to 4 collecting areas. Meter readers are given computer lists of subscribers as a basis for making their readings. Readers generally complete their work in assigned areas in 2 to 6 weeks and return the completed records to the area clerk.

Meter readings are then transferred manually to reading books by the area clerk who compares the readings with those of the previous period. Notices concerning stopped meters are sent to the meter section of the Operations and Maintenance Department, and the area clerk makes an estimate of consumption for billing purposes. Reading books are then transferred to the computer section where data entry operators transfer readings to the computer system.

Bills are calculated by the computer and printed; printed bills and the reading books are then returned to the area clerks for checking (pre-audit). After being checked, the bills are sent to collection sections for distribution to meter readers, who also perform bill distribution and, in some cases, collection duties.

Table 4
UNACCOUNTED FOR WATER
ACTION PLAN COSTS

Activities	Estimated Cost
1. Under registration of subscribers' meters	JD 1,115,867
2. Defects in water source meters	189,255
3. Errors in reading subscribers' meters and billing	51,700
4. Illegal connections	8,690
5. Leakage	
- Reducing pressure in water networks	550,000
- Water hammer in networks	120,000
- Upgrading employees of networks	50,000
- Reservoir maintenance	556
- Periodic leakage survey	197,250
- Network pipe protection	70,000
Total	2,408,362

Note: The Action Plan costs were calculated and estimated for all stages after adding 10 percent for contingencies.

Source: WAJ, Unaccounted for Water, June 1988.

Subscribers may make payments directly to the collector, at the local WAJ office, or at any branch of the Housing Bank.

The meter section replaces stopped meters and conducts tests on meters in connection with subscriber's complaints. Subscribers wishing to have their meters tested must pay a fee of 2 JD and one-half of any disputed bill amount.

There are numerous weaknesses and shortcomings associated with the present system and WAJ's Action Plan is aimed at correcting the situation. Problems to be addressed include poor organization of reading/collecting routes, insufficient data for locating subscribers, lack of workload assessments among readers, lack of qualified readers, lack of transportation for readers, lack of document controls at various stages of the process, absence of monitoring and follow-up, and an absence of written procedures regarding various steps in the process including methods for estimating bills or handling exceptional cases such as illegal connections and missing or inaccessible meters.

WAJ's short term action plan for dealing with these deficiencies within a six-month period is estimated to 51,700 JD.

2.2.5 Non-Revenue Water

Various estimates place non-revenue water in WAJ at 50 percent or more of total water production. Ongoing studies for Amman prepared by SOGREAH, Jouzy and Partners, and WCS Operations Management avowed non-revenue water at 52 percent in 1986 and 59 percent in 1987. WAJ's own study of the situation, presented in its report "Unaccounted for Water," showed unaccounted for water at 54 percent over the entire Kingdom. The principal elements of unaccounted for water are considered by the SOGREAH group to be leakage (20 percent), under-registration of meters (18 percent), errors in measurement of production and transmission losses (7 percent), and administration losses (14 percent). These proportions will vary significantly from location to location within the system. Some of the key points concerning non-revenue water are discussed below. All such items are addressed in the aforementioned Action Plan for reducing unaccounted for water.

Administrative - Non-revenue water is adversely affected by administrative weaknesses in WAJ's revenue systems and organization. These include inability to identify and deal promptly with stopped or under-registering meters, lack of procedures and controls to constrain bill adjustments, lack of controls which allow some subscribers to go unbilled, lack of criteria for placing properly sized meters in new connections, inability to detect illegal connections, lack of follow-up, and inadequate supervision and control necessary to assure the propriety of dealings between meter readers/collectors and the subscribers. WAJ's Action Plan for dealing with these deficiencies is almost entirely administrative in nature and involves only minor expenditures.

Subscriber Meter Under-Registration - The inaccuracy and unreliability of subscriber metering has been a constant difficulty over the years. Despite commitments on the part of WAJ to correct the deficiencies, the problem persists, stemming from the long history of random purchases of meters without

full regard for the conditions under which they will be required to operate. Prior to the formation of WAJ for example, many subscribers, especially outside of Amman, were permitted to select their own meters.

Tests made in 1985 on about one percent of the total meters installed throughout the Kingdom showed meter accuracy at about 62 percent. Accuracy in Amman was 81 percent compared with only 54 percent in the remaining areas. About 17 percent of the meters tested were stopped.

WAJ's Action Plan focuses on both short- and long-term approaches, with the short-term program concentrating on the replacement of 61,300 small meters and 4,000 large meters of 1 inch size and above. The long-term program would involve significant improvements in data collection and analysis of problems in metering to support research concerning optimization of meter design, focusing on the various conditions in water quality throughout the Kingdom. Prompt recognition of meter defects and immediate action for replacement, testing, and repair would also be initiated. Where feasible and appropriate, flushing of distribution system lines and greater use of reservoirs would also be initiated to reduce particulate matter which are a primary cause of stoppage or under-registration.

While the Action Plan appears basically sound, further analysis of meter design appears warranted before implementation. It would, for example, seem unwise to replace over 61,000 meters before completing at least a preliminary analysis to identify the most suitable meter designs for various conditions to be encountered.

Leakage - The Action Plan includes significant investments in both immediate and long-term approaches to leakage reduction. The immediate program includes pressure reduction in areas where pressure is in excess of the normal requirements. This would reduce the rate of water loss through existing leaks until such time as repairs or replacements can be made. The immediate program also includes action to reduce water hammer which places excessive stress on the distribution system components. In some cases existing surge tanks or pressure relief valves have been bypassed and can be easily reactivated. In other cases, new facilities will be installed. Strengthening of leak repair procedures will also be undertaken.

The long-term program involves establishment of an ongoing leak detection capability by district metering (segmentation of the distribution system into areas with the capability of measuring water flows into the area). After capabilities are established to identify the amounts and locations of leakage in the system, repair vs. replace decisions can be made. Analysis of distribution system materials will also be made to identify problems and more suitable alternative materials. This is particularly important as system analyses show that the use of steel pipe has contributed significantly to corrosion and associated deterioration and leakage.

Production Metering - Accurate measurement of water production is an essential component of a water loss reduction program. A survey of metering at water production facilities conducted by WAJ showed that 16 percent were unmetered and that 43 percent were inoperative. Functioning meters, furthermore, were determined to be generally inaccurate. The causes of meter inaccuracy or

meter stoppage were diagnosed as lack of appropriate servicing and maintenance and/or the presence of fine sand in the water. WAJ's program to correct these deficiencies includes the procurement of 49 new meters and the rehabilitation of the remaining deficient meters. The Action Plan provides that all new meters will be the electrical type in order to be compatible with plans for future use of automated monitoring and control systems.

Chapter 3

IMPACT OF USAID ASSISTANCE IN WATER AND WASTEWATER

3.1 Institutional Development

AID's assistance in the provision of grants and loans has had and continues to have a major beneficial impact on the Jordanian water and wastewater sector. Long-term "soft" loans have been provided in support of capital improvements in seven urban centers. AID also provided funding for an additional seven cities and towns for design and construction supervision services. Grants have been made available to support feasibility studies, technical assistance and other projects focusing on institutional development, training, technology transfer, and tariff-financial management issues. The portfolio of projects involved in these efforts includes:

- ♦ Amman Water and Sewerage
- ♦ Irbid Water and Sewerage
- ♦ Aqaba Wastewater
- ♦ Zarqa-Ruseifa Water and Wastewater
- ♦ Water Systems and Services Management

The principal features of AID's efforts and the results of its participation through these projects are highlighted in this chapter. Given the nature of the inquiry, it was also important to raise a series of questions about the beneficiaries in order to put the technical issues into perspective. To address these issues on beneficiaries a series of questions were raised and the responses and observations are woven throughout the report. The critical questions addressed concerning beneficiaries are as follows:

1. To what degree have beneficiaries connected to the system?
2. What is the rate of collections?
 - ♦ Are collections being made equitably?
3. What is the quality of water?
 - ♦ How do consumers perceive quality?
 - ♦ Have AID investments facilitated more regular availability?
 - ♦ Has the expansion of service been equitable?
 - ♦ What has been the experience in low-income areas?

4. Urbanization and Industrialization

- ♦ Is the concept of infrastructure-led growth being employed?
- ♦ Are water and sewer lines being extended simultaneously?
- ♦ Are there difficulties incorporating new expansion areas?
- ♦ Are industrial users receiving an adequate supply?
- ♦ Are there GOJ plans to handle future industrial requirements?
- ♦ What are the attitudes of industrial users--especially on discharges?
- ♦ Is there a rational pricing structure for industrial clients?

5. What is WAJ doing to promote water conservation?

- ♦ Are there viable outreach program opportunities?
- ♦ Is there an organized public relations program?

3.1.1 Quality of Design and Construction

An impressive program of capital works in both water supply and wastewater collection and treatment has been implemented by the GOJ over the past decade with assistance from AID and other funding agencies. Details of this program are discussed in Section 3.1.3 and an outline of major facilities is shown in Table 7.

In all of the projects, foreign consultants, who were specialists in the sector, were carefully selected to participate in preparation of designs and specifications and in supervising construction. In the earlier years foreign specialist consultants were invariably the lead firm in associations of foreign and Jordanian consultants. More recently, however, as local firms gained experience they have been given more responsibility and ultimately the roles of the early days are reversed. Throughout this period, high quality construction standards were maintained through careful selection of consultants and insistence on a high quality of design and detailed specifications. These specifications were carefully prepared to exclude low quality workmanship and materials and were appropriately adapted to Jordanian conditions. Attention was also given to training Jordanian engineers in all aspects of construction work, both consulting engineers' staff and Water Authority staff. Through this meticulous attention to detail, high standards of construction were developed in earlier years and maintained to the present day. The high standards of construction were evident to the team engaged in this study as the major construction projects were visited and examined.

3.1.2 Building Management Capabilities and Recovering Costs

The AID assistance effort has gone far beyond the mere provision of capital for the development and expansion of facilities. It has also been adaptable to changing circumstances and responsive to institutional dynamics in the sector as the GOJ has undertaken a series of major reorganizational steps. The features of AID's assistance pertaining to utility management and finance are discussed below.

Management Training - AID projects have included training inputs for WAJ (and predecessor organizations) managers and support staff as well as for the technical disciplines. Most of the training provided directly under the water and wastewater projects has focused on technical fields including operations and maintenance. Managerial and other nontechnical staff training has been provided under AID's general training assistance project. Under that project, WAJ staff have been sent to the United States to receive training in such subjects as manpower planning and development, computer science, procurement and contracting, water and wastewater utility management, personnel management, accounting, and public administration in general. Since 1984, AID has financed such training for 21 employees and managers of WAJ. The benefits to WAJ of training in managerial and administrative subjects are not quantifiable. Although it is clear that western management practices are not fully applicable in developing countries, it is safe to say that the long-term impact of such training is surely positive. In some respects, overseas training in the various managerial skills is more appropriate than attempts to train operators and technicians at U.S. water and wastewater facilities.

Advisory Services - Advisory services are being provided through the Water Systems and Service Management Project. A major consulting assignment focused on institutional development has been funded under that project. Approximately 80 person-months of professional consulting services will be provided in human resources development, institutional development, financial management, systems analysis, water quality and operations and maintenance. In addition, short term specialists will be provided as needed. The project was commissioned in July 1987 and will last 24 months.

The start-up of this project nearly coincided with WAJ's appointment of a new Secretary General. As a result, some of the priorities have changed, with greater emphasis now on reorganization and water quality monitoring, as well as providing for increased participation by local experts. The AID-financed consulting team has provided major inputs to WAJ's reorganization plan and is participating in organizational planning for the new ministerial level arrangements. The increased local participation is being provided under this project by the Jordan Institute of Public Administration. AID has been responsive to and supportive of the changes in priorities. There are indications that additional resources may be required to support this project, which AID is likely to be asked to provide.

In addition to the foregoing, AID has provided funding through the Zarqa-Ruseifa Project for a senior person (host country hire) to work within WAJ to provide advisory services on a day-to-day basis. Efforts are currently in process to provide for the continuation of this assignment.

Cost Recovery - AID projects have consistently supported the concept of a financially self-sufficient water and wastewater operations. Since the project agreements were entered into prior to the establishment of WAJ, the conditions precedent or covenants were stated in terms of the expected financial results for individual municipalities. AWSA and WSC were committed through the various loan agreements to develop sufficient levels of income to support the operations and capital programs in the municipalities where the capital investments were to be made. Although the exact language varies slightly among the projects, the intent of these provisions is that tariffs and other sources of subscriber-based income would be developed in amounts sufficient to cover operations and maintenance (excluding depreciation), as well as interest and principal repayments on debt. In the case of Amman, the borrower agreed to review water and wastewater rate schedules with AID during the course of the project and to devise a plan that would make "...AWSA financially viable."

The Amman and Zarqa-Ruseifa Projects both included participation by the World Bank which also negotiated covenants to the effect that water and wastewater entities must be operated on a financially sound basis. The terms of the Bank's covenants were in some cases more demanding than those established by AID. The Bank's covenants included provisions for coverage of working capital needs and a contribution to capital investments to be made from current revenues, as well as the basic requirement for covering operations, maintenance, and debt service costs.

AID also consistently covenanted provisions that on one hand required revenue programs aimed at financial self-sufficiency, and on the other hand required that special attention be given to assure accessibility to the water and wastewater systems by lower-income households. AWSA was required, for example, to conduct studies aimed at identifying financial constraints which would limit accessibility, and to identify any measures needed to assist such lower-income households. AWSA established a policy permitting lower-income families to pay sewer connection charges on an installment plan basis. A subsequent study by AID and AWSA revealed that 95 percent of households in a lower-income area had connected within the first 8 months following notification and that none had elected the installment plan. It was therefore concluded that the issue of accessibility may be less critical than had been anticipated. This may also explain the apparent current reluctance of WAJ to extend installment plan arrangements to new subscribers.

With the establishment of WAJ and the consolidation of all financial reports, it is not possible to determine from the routinely prepared reports the extent to which these covenants or conditions have or have not been met. Given WAJ's overall financial status however, it seems probable that the objectives of the covenants and conditions have not been met. On the other hand, AID's impact has been positive. It seems unlikely that tariffs and revenues would have increased so dramatically during the 1980s in the absence of AID's consistent support for financial strengthening. If anything was lacking from the earlier terms and conditions of AID projects, it was in the area of requirements for taking action to achieve improved metering, billing, collecting systems, and water loss reduction.

The impact of the Tariff Study, financed as part of the Zarqa-Ruseifa Project, remains to be determined. The recommended tariff levels seem extraordinarily high by almost any standard and the report fails to offer and explore basic cost recovery options. The recommendations are tied to specific points in time, with implementation to have begun in 1987. Technology transfer, in the form of a computer model (and staff trained to use it), which could have been left with WAJ for use in assessing optional approaches, changing assumptions, and making adjustments needed for the passage of time, was not achieved. For this reason, it will be difficult for WAJ to usefully apply the report.

Financing Terms - AID financing terms have consisted of grants (about US \$11.5 million) and soft loans (approximately US \$94.5 million) for the five projects under review. Except for the Water Systems and Services Project, loans have been offered for a 40 year overall term including a 10 year grace period with interest at 2 percent per year during the grace period and 3 percent thereafter. The loan terms under the Water Systems and Services Project would still be considered "soft" but were closer to commercial rates with an overall 20 year duration including 5 years' grace and interest at 5 percent throughout.

The benefit of the grant funding is passed through directly to WAJ (WSC and AWSA). The relending agreement between the GOJ (National Planning Council) and WAJ, however, does not pass through the benefits of the soft loan terms. The relending terms vary slightly, but generally include a 24 year overall term including 4 years grace and 8 percent interest. WAJ is responsible for complying with all conditions and covenants established in the loan agreement between AID and the GOJ and must bear the exchange risk. Subsequently WAJ must bear all of the risks, comply with all loan provisions, and make debt service payments considerably above those required by the basic loan agreement. In the aggregate, during the first ten years of the loans, WAJ is required to pay the Ministry of Planning well over US \$60 million more than the GOJ is obligated to pay to the United States for the loans in question. In this respect, the impact of AID soft lending terms does not accrue to WAJ or its subscribers.

3.1.3 Improvements in Water and Wastewater Services

The GOJ has made remarkable progress in the past 15 to 20 years in overcoming inherent difficulties arising from the scarcity of water in Jordan and the high cost of developing water supply services. It has embarked on a large program of water projects, particularly in the upland areas of the northwest, to relieve shortages. In more recent years, in an effort to control environmental pollution and to make more water available for irrigated agriculture, the Government, aided by WAJ and JVA, has succeeded in establishing acceptance of the concept of re-use of treated wastewater and has

embarked on a program to develop wastewater collection and treatment facilities in urban centers. The level of planned and actual investments in the sector are indicated as follows:

Table 5
Water Sector Investments
1981-85 and 1986-90 Plans (JD million)

	<u>1981-85</u> <u>Actual</u>	<u>1986-90</u> <u>Planned</u>
Irrigation and Dams	72	117
Water Resources	79	12
Water Systems	35	63
Wastewater Systems	60	88
	<u>246</u>	<u>280</u>
Percent of Public Investment	9.8	16

(Source: Ministry of Planning)

The 1986-90 GOJ plan focuses on completion of irrigation projects and on expansion of the urban sewerage systems.

In implementing this large and important program of works, assistance was provided by several bilateral and multilateral aid agencies. Assistance provided by USAID is illustrated in Table 6. This table provides an indication as to the geographic areas in which improvements in water supply and wastewater were implemented and identifies the major components of each project. Important aspects of the program and some of the improvements in services which resulted are discussed below.

In formulating a wastewater program, WAJ gave priority to 1) densely populated urban areas where the use of individual systems of waste disposal were impracticable, and 2) areas where ground conditions were unsuitable for the use of septic tanks or cesspits due to low permeability factors. In these individual systems, accumulated sludge is pumped out by municipal or private tank trucks for disposal at wastewater treatment facilities or approved dumping areas. Cesspool facilities operate with varying degrees of efficiency depending on soil conditions, loading and capacity ratios, and the regularity of desludging and emptying operations. There is a serious risk that percolation from cesspits or the overflow from neglected facilities will reach surface or groundwater sources, or at least will cause considerable nuisance or health risk, particularly in densely populated areas. The policy decision by WAJ to replace these facilities with piped systems in selected urban areas was therefore appropriate, as was the AID decision to provide substantial support for this endeavor. This decision benefited lower-income residents, who tend to be disproportionately located in densely populated urban areas.

Table 6

Illustrative Allocation of AID Loans & Grants

Project Town or Area	Treatment Plants		Water Distr. Mains Length.km	Wastewater Sewers Length.km	Reserv. Cap. M ³	Pump Stns. Cap. M ³ /d	Project Cost JD/US \$ millions (A.I.D. Contribution)
	Water Cap.M ³ /d.	Wastewater Cap.M ³ /d.					
Irbid	-	12,000	100	200	-	-	\$ 53.300 (\$23.500)
Zarqa, Ruseifa	-	68,000	43	162	-	-	\$ 103.200 (\$15.000)
Aqaba	-	9,000	-	-	-	-	\$ 15.500 (\$7.500)
Amman-Zai Water Treatment System	125,000	-	Transm. mains 49	-	250,000	31,000	\$108,000 (\$39.000)
<u>Ten Cities Project</u>							
Ajloun, Ein Jannah Anjara, Kufranjeh	-	1,800	49	68	-	-	JD 3.284
Ma'raq	-	1,800	6	51	-	-	JD 1.494
Rantha	-	-	33	74	-	-	JD 2.066
Ma'an	-	1,200	20	53	4,500	-	JD 1,819
Tafila	-	1,600	17	48	1,000 4,500	-	JD 4,407 (\$10.32)
Karak	-	800	-	37	-	-	
Madaba	-	2,000	62	51	-	-	JD 3.250
Engineering Design Services	-	-	-	-	-	-	(\$2.600)
Construction Supervision	-	-	-	-	-	-	(\$5.680)
Institution Bldg	-	-	-	-	-	-	(\$0.300)
Training	-	-	-	-	-	-	(\$1.970)
Unallocated	-	-	-	-	-	-	(\$0.130)

WAJ also made a conscious decision to treat effluent from some of these piped wastewater facilities so that it could be re-used for (controlled) irrigated agriculture.

One of the larger wastewater treatment plants assisted by AID serves the Irbid urban area, Table 6, where it will meet the needs of some 70 percent of the 150,000 population. The treatment process is suitable for both the type of waste that the plant will receive and the discharge of effluent to a water course from whence it will eventually reach a reservoir used for controlled irrigation. However, the plant treatment process is complex and will require skilled operators and maintenance personnel which may initially be beyond the capability of WAJ to provide. A question arises, therefore, concerning this plant (and possibly to a lesser extent those at Karak and Tafila) as to whether a more extensive review could have been carried out at the plant design stage to simplify operation and maintenance tasks without losing plant function and efficiency, particularly in the sludge handling stage.

The Aqaba wastewater treatment plant which employs waste stabilization ponds is entirely suitable from all aspects. Proposals include the eventual use of the entire effluent for controlled irrigation which is also satisfactory. The "ten cities" project, which includes the construction of the wastewater systems at Karak and Tafila, also includes components for technology transfer (Section 3.2.1) associated with AID assistance for engineering design services, construction supervision, institution building, and training. Thus, in addition to successfully providing desperately needed wastewater systems for the centers of smaller urban areas, these projects also made a successful impact on equally important institutional aspects of development needs. This national approach has led to generally equitable development or services areas.

In the Zarqa and Ruseifa wastewater project, wastewater collection and pumping facilities were provided for the collection and transfer of domestic, and some industrial, wastes from these densely populated urban centers to the relatively new (1985) waste stabilization ponds at Khirbet Al Samra. Part of the effluent from the Al Samra plant flows via the Zarqa river to the King Talal reservoir, which provides water for controlled irrigation in the Jordan Valley. The AID contribution to this project was concerned primarily with the wastewater collection system in which there have been delays in construction caused primarily by financial difficulties on the part of the contractor. These issues have now been successfully resolved; they have not detracted from the success of the project and could not have been foreseen or avoided in the initial contract bidding and award procedures.

The Ain Ghazal wastewater treatment plant, which was partially renovated with AID assistance and formerly served part of the Amman area, has been discussed elsewhere in this assessment. The plant (capacity about 60,000 cubic meters per day) was replaced by the Al Samra facility in 1985 and is now largely unused with the exception of stages for grit and screenings removal. A study to determine the future of the plant would be appropriate since the Al Samra facility is now reaching its design capacity, and some portion of the flow might economically be diverted to Ain Ghazal providing effluent could be used to irrigate the nearby Zarqa valley area (if the effluent is of suitable quality).

Regarding water supply improvements, AID has responded to the GOJ objective of providing piped water to all sections of the population. AID has contributed construction of a water treatment plant (the Zai plant designed to supplement the Amman supply) and the water distribution facilities in Irbid, Zarqa, Ruseifa, Tafila (Table 6). The Zai plant is discussed in Chapter 5. Although there has been recent criticism of the effectiveness of the plant and it is at present out of service, the issue is one of operating competence and is not concerned with the design of the plant process. As described in Chapter 5, the plant incorporates a complex treatment process and the design includes relatively sophisticated instrumentation. Although the provision of high degrees of plant complexity and sophistication are attractive elements at the design stage, their inclusion requires careful scrutiny and consideration in view of the inherent operation and maintenance difficulties which they generate. Although more simply designed plants require more manpower, they may be more suitable for developing countries to operate and maintain. Treatment processes are equally effective in both complexly designed and simply designed facilities. The Zai plant is suitable for effective treatment of raw water of the quality which was received during the summer of 1987 incident, provided that competent operators are on hand to identify the optimum treatment process and to apply it, and provided that all mechanical, electrical, and instrumentation equipment is effectively maintained.

A transient issue which has tended to marginally detract from an otherwise impressive development program is associated with coordination of construction timing of the various elements of the projects. This applies particularly to wastewater projects where, in several cases, wastewater treatment facilities representing a substantial level of investment remain idle for long periods awaiting completion of wastewater collection facilities and service connections. The cause is a combination of lack of planning and a reluctance on the part of potential customers to connect to the system (which is discussed in Section 2.2.3 of this report). Both aspects could be improved with appropriate remedial action.

The approximate total costs of water and wastewater projects which have received AID assistance (based on a uniform conversion rate of US \$2.80 to 1 JD) is \$371 million of which AID assistance is about \$106 million, or 28.6 percent. The AID-assisted WAJ project of water and wastewater improvements has been remarkably successful in achieving a much higher than average level of water and sewerage services throughout the Kingdom. WAJ estimates of service levels are as follows:

Water and Wastewater Service Levels - 1985			
	<u>Urban</u>	<u>Rural</u>	<u>Total</u>
<u>Water Supply</u>			
House Connections	85	17	65
Public taps	5	61	22
Tankers	10	8	9
No supply	<u>-</u>	<u>14</u>	<u>4</u>
<u>Wastewater</u>			
Piped systems	45	0	51
Septic tanks and cesspits	54	90	65
Other	<u>1</u>	<u>10</u>	<u>4</u>
	100	100	100

3.1.4 Improvements in Water Quality

Groundwater sources provide most of the water used for domestic, commercial, and industrial purposes, excluding water for irrigated agriculture. Groundwater in Jordan is of excellent quality, and protection of sources from contamination therefore assumes a higher priority than water quality improvements per se. The development of wastewater collection facilities by WAJ with assistance by AID funding, designed to replace cesspits in urban areas, has substantially reduced the risk of adverse environmental effects and contamination of groundwater sources as discussed in Section 3.1.3. A further objective of this program is to increase the availability of water for agriculture by the use of treated wastewater, as discussed in Section 5.2.

The monitoring and control of industrial waste discharges, as a further measure to protect the environment and surface and groundwater sources, is discussed in Section 5.3.

Most groundwater sources in Jordan yield water of a quality suitable for potable use with only the added safeguard of disinfection by chlorination. One exception is water from the Mukheiba well field, part of which is used to supply the town of Irbid. This water was found to contain moderately high levels of iron, and a water treatment plant was recently constructed to improve the quality of that portion of water supplied to Irbid. Consumer complaints regarding the calcium carbonate hardness (400 to 450 mg/b) of this source are being considered, with a possible solution being blending the water with another source of supply to improve the quality. However, the degree of hardness is not excessive by international standards. At present the only other treatment plant in the Kingdom for a municipal water supply is the Zai facility, which is discussed in Section 5.1. In view of the importance of the plant, the complex nature of its raw water source, and the recent controversy over its operation, water quality aspects of the system are further discussed below.

The raw water source for this plant is the King Abdullah Canal (KAC) which conveys water from the Yarmouk River, the Mukheiba Wells, Wadi Arab Reservoir, and the King Talal Reservoir (KTR). The Yarmouk River quality is reported¹ as being normal for a surface water source of this type with little urbanization and with now excessive contaminants, but with large quantities of silt and suspended organic material during heavy rainfall. Difficulties from the presence of excessive algae in dry weather may arise, but this factor has not, as yet, been fully assessed. If under a tentative agreement between GOJ and Syria a dam is constructed at Magrin, then the quality of water would change substantially with both good and bad effects on the water treatment potential.

Water from the Mukheiba wells is of good quality; however, the presence of hydrogen sulfide, dissolved iron, and traces of ammonia requires that it be blended with other sources. The water quality under these conditions is satisfactory.

The Wadi Arab Reservoir receives water from four sources: its own catchment, springs, pumping from KAC, and treated wastewater from the Irbid treatment plant. It supplies water for irrigation and augmentation of KAC. The quantity of wastewater effluent reaching the reservoir is at present very small. The Thames Report states that, provided the quality of effluent from the Irbid wastewater treatment plant is maintained at design levels, there should be no adverse effects in the Wadi Arab Reservoir water, although careful monitoring of nutrient loading (nitrogen and phosphorus) from the Irbid wastewater treatment plant would be necessary.

¹ Water Treatment and Water Resources Planning, Thames Water International. Draft Report. January 1988 (subsequently referred to as "The Thames Report").

There have been extensive studies of the KTR by the University of Jordan and the Royal Scientific Society. The quality of the reservoir water is well documented in the Thames Report. The Al Samra system of waste stabilization ponds (Section 3.1.3) was designed to treat wastewaters from the Amman, Zarqa, and Ruseifa areas and to supplement flow to the KTR for use in agricultural irrigation in the Jordan Valley. Subsequently a decision was made to transfer part of the KTR water to KAC and thence to the Zai water treatment plant. Much of the discussion concerning the quality of KTR is based on extensive sampling and analysis program implemented by the Royal Scientific Society (RSS).

Although there has been considerable concern as to whether the contribution of treated domestic and industrial wastewater, primarily from the Al Samra plant, could limit the future use of KTR, the RSS has found that the present level of contribution is acceptable, subject to appropriate management of the whole catchment.

This conclusion leads one to question the origin of the problem which caused widespread complaints of water quality by Amman consumers in the summer of 1987. From a report reviewed during this study the incident may be summarized as follows:

- ♦ Water from the lower levels of the reservoir were conveyed to KAC. (The reasons are unclear).
- ♦ RSS analyses indicate that at that time these lower levels of water were devoid of oxygen although not entirely anaerobic.
- ♦ The presence of algae and organic material (probably dead algae) in these lower levels would have produced unpleasant tastes and odors, probably exacerbated by chlorination.
- ♦ Water treatment processes built into the Zai treatment plant could have effectively removed the objectionable taste and odor.
- ♦ These treatment processes were not activated even though the treatment plant personnel were aware of the marked deterioration in the quality of the raw water.
- ♦ As an alternative to adjusting the treatment plant processes to cope with the inferior water quality, the plant could have been shut down without serious impact on the Amman supply.

The lessons learned from this (fortunately) harmless incident illustrate clearly the need to:

- ♦ Protect water sources from unanticipated, sometimes harmful changes either from natural causes, intentional irresponsible dumping of wastes into water courses or catchments, or discharge of industrial wastes to the environment or to wastewater collection systems.
- ♦ Maintain water and wastewater treatment facilities in peak operating condition at all times.
- ♦ Monitor the quality of water sources and wastewater treatment plant effluents; understand and respond to results of these monitoring operations.
- ♦ Routinely examine water and wastewater facilities to ensure their effective operation by staff who are experienced and competent to maintain the facility and operate it consistently and reliably, even under adverse conditions.

Where such experienced and competent staff are not available, as is clearly the case in the Zai plant and possibly others, then consideration should be given to "contracting out" the responsibility to a consortium of foreign and Jordanian firms which have the ability to operate and maintain the facility reliably until WAJ staff can be trained and become sufficiently experienced and dependable to resume operating responsibilities.

As discussed above, water and wastewater quality monitoring are an essential component in maintaining acceptable and consistently safe levels of water service and in controlling levels of environmental pollution. In addition to monitoring industrial wastes (Section 5.2) and raw water sources (discussed above), quality monitoring is necessary within water and wastewater facilities to control treatment processes and assure an acceptable standard of effluent, and in water courses which receive effluents from wastewater treatment facilities. And finally, there is need for water quality examination in water distribution systems.

WAJ has long been aware of the needs outlined above and, assisted by AID and other donors, has made provision for laboratories in all of its water and wastewater treatment facilities, in addition to training laboratory staff and establishing a large central laboratory. The WAJ central laboratory is under the direction of the Director of Laboratories and Environmental Control (DLEC) who is responsible to the Secretary General of WAJ for monitoring the water quality of all underground and surface water sources throughout the Kingdom. The DLEC is responsible for evaluating the results of sampling and analysis operations of the Central Laboratory, making judgments as well as identifying and implementing appropriate follow-up actions. Unless some urgent or unusual event occurs, a monthly report on DLEC activities is submitted to WAJ Secretary General. As part of a routine procedure most samples are taken

weekly but some less often. Wastewater and water treatment facilities monitor quality daily, with the aid of on-site laboratories, and send results to the DLEC weekly.

The legal responsibility for water quality reportedly rests with WAJ, presumably with DLEC. Although the Ministry of Health has responsibility for health-related items including drinking water quality, it checks and examines only a limited number of water samples and is reported to have inadequate capacity to further extend its activities. WAJ informs MOH of any serious water quality issue that may arise, and is now developing proposals for a more extensive quality monitoring program to better protect health. It is understood that Thames Water International has been assigned to evaluate all water monitoring laboratories in the Kingdom as a first step toward improving and standardizing water quality monitoring activities.

This is commendable and presumably will bring better coordination than that which presently exists. Some confusion may be due partly to a failure to assign responsibilities and a proliferation of laboratories, including plant laboratories in each of the WAJ water and wastewater facilities, WAJ Central Laboratory, the Royal Scientific Society, the Ministry of Health, the University of Jordan, and the Municipality of Greater Amman.

The WAJ Central Laboratory is impressive, as is that of the Royal Scientific Society, although both of these establishments lack funds for certain essential equipment. Although the WAJ Central Laboratory is very capable, it is normal in other countries to assign an independent authority to monitor water quality rather than having a water authority audit its own product.

Since the whole aspect of water quality monitoring is at present under study by consultants (Water/Wastewater Sector Training, Water Quality Monitoring and Technical Advisory Services - CH2MHill and MBC) these deficiencies, and others, will be more fully explored and addressed. The study is financed by AID.

3.2 Construction of Facilities

3.2.1 Contracting for Design and Construction Services and Technology Transfer

In 1983 AID developed a Water Systems and Services Management Project designed to improve the institutional capability of public and private sector organizations. One of the objectives of this project was to strengthen the capability of Jordanian consulting engineering firms in the design and supervision of construction of water, wastewater, and stormwater drainage systems.

Under the project three Jordanian consulting engineering firms were selected by the Water Authority of Jordan to design and supervise construction of water, wastewater, and drainage systems for ten small towns, ranging in population from 4,000 to 30,000. The systems for the six smaller towns were designed by one firm, and systems for four larger towns (each with more than 10,000 population) were divided between two firms, each having two towns.

Transfer of design technology was provided by an association of U.S. engineering consultants (under subcontract) with each of the three Jordanian engineering consultants.

The three Jordanian consulting firms were Arabtech Consulting Engineers, a well established firm but without prior experience in the sector; Consulting Engineer Center (CEC), a small firm with limited experienced staff; and Jouzy and Partners Consulting Engineering Bureau, a large firm with overseas interests. U.S. consulting firms were CH2MHill International, Black and Veatch International, and Engineering Science Inc. respectively.

Technology transfer methods adopted by the U.S. subconsultants varied in some respects but all used lectures and one-on-one training methods, which appeared to be successful. All subconsultants assisted with both administrative and technical work items. It is of interest to note that in addition to lectures, accompanied by adequate handouts, the subconsultants were needed to assist the smaller firms with technical problems and in general were able to strengthen the confidence of Jordanian personnel. It was also found to be necessary to isolate the U.S. subconsultant from any responsibility for the project and have him maintain a strictly advisory role.

Construction inspection manuals, produced by CH2MHill and Black and Veatch, were found to be effective in ensuring that adequate inspections were made and proper records maintained. CEC originally specialized in materials and soils testing; however, CEC was able to design all of the water and wastewater systems for Madaba and Karak and was subsequently selected by WAJ to supervise construction services.

Jouzy and Partners designed water and wastewater collection facilities for six (northern) cities. Since this firm had provided construction supervision services to clients in the region for several years in a variety of sectors, including several water and wastewater construction projects, they were also selected by WAJ to supervise construction of the six northern cities facilities. Despite their previous experience they reportedly benefited from systems for the construction supervision manuals prepared by their subconsultants, Engineering Science.

The methods of promoting technology transfer were unique to this innovative project. The objective was clearly achieved in that all three firms showed improvement in design and construction supervision skills and in project administration, as well as gaining confidence and experience to compete for similar work in the sector.

3.3 Operations and Maintenance

3.3.1 Training

A contract to address and to respond to the institutional development and training of WAJ staff was awarded to the firms of CH2MHill International, James M. Montgomery Consulting Engineers, and Brown & Caldwell Consulting Engineers.

The project is to develop and improve the viability of WAJ's water quality monitoring procedures, training of water sector employees, improve operation and maintenance capabilities and establish a training center.

The scope of work included a reorganization of WAJ, through the joint efforts of the consultants and the Jordan Institute of Public Administration. Job descriptions were also developed for the various classifications in WAJ.

The project's main goals in the training sector were:

- ♦ Evaluation of the existing WAJ training facility for present and future needs by review of the physical facilities for space, the amount of equipment (videos, overhead projectors) and the number of formalized training courses that are available. The project will also determine if additional and appropriate training can be supplied by other training organizations.
- ♦ Selection of WAJ trainers, determination if they should be full-time or part-time employees, and evaluation of their expertise and ability to train students.
- ♦ Selection of the training format to be evaluated based upon a needs survey. This will determine if in-house training, hands-on training, or a formal training course should be developed.
- ♦ A review of the training resources as to what courses are available on site and what additional material should be obtained.
- ♦ The training program will be tailored to fit the needs of WAJ personnel and will make use of formal, hands-on training in operation and maintenance of water/waste-water systems and include financial and management training.

The operations and maintenance areas to be reviewed and areas in which recommendations are to be made include:

- ♦ Present operational procedures for water/wastewater systems including transmission and collection systems; a management information system consisting of work orders, spare parts inventory; record keeping and data collection; and safety and emergency procedures.
- ♦ Performance appraisal standards for trainees and feedback reports for courses as part of the O&M review.

- ♦ Additional training in the United States for selected WAJ personnel to observe the operations and maintenance of various types of treatment processes. These visits will last approximately two to three months.

This project should provide more experienced trainers for WAJ in the water/wastewater field and provide for standardization of courses and coordination of training activities by the various agencies. From an O&M standpoint this program should improve operational procedures, optimize process control, and improve water quality. It will also allow for improvement in employee relationships and provide incentives for promotion.

3.3.2 Start-Up

Currently the contractor has the responsibility to provide all personnel to operate and maintain the facility during the maintenance period. The contractor is also required to train the owners' personnel in the operation and maintenance of the equipment and processes. This type of training normally lasts two to four months.

It seems clear that additional training/advisory services should be provided after the facility has been in operation for a year since this is when operational problems typically begin to occur, especially when some processes, e.g., anaerobic digestion, are just being placed on line. This additional service of one month duration quarterly by an O&M specialist would provide the opportunity for the optimization of the processes and to ensure that cost effective measures are being implemented.

It is imperative that the WAJ operating personnel be assigned and available and that key personnel be on site prior to the completion of construction. This would allow the personnel to become familiar with piping and location of valves and to start setting up the critical preventative maintenance program.

Chapter 4

LESSONS LEARNED

In any human endeavor, there are lessons to be learned from experience. AID's experience to date in the water sector has been generally positive. Some lessons which have been gained from the assessment are summarized in this chapter.

4.1 Financial and Institutional Lessons

Changing Nature of Clientele: When AID entered into project assistance agreements in the past, it was dealing with WSC and AWSA on projects involving a discrete group of cities and towns. Conditions precedent and covenants were therefore related to these individual municipalities. With the establishment of WAJ, the nature of the organization of the water sector has changed. The majority of WAJ's subscribers can now be considered rural. This may suggest that AID should re-evaluate its positions on key issues in the sector, especially in such areas as cost recovery and pricing policy.

Newly Established Wastewater Systems Require Subsidy: Wastewater systems newly initiated in a community require heavy initial investments. There is an inevitable lag between the time of the investment and the build-up of the revenue stream from connected premises. Delays can be encountered in the construction of laterals and collectors for a variety of reasons including restrictions established by municipal police and traffic officials. Some form of financing assistance or subsidy over a period of years is typically expected (e.g., U.S. system of grants).

Establishing Cost Recovery and Pricing Policy as a Basis for Tariff Setting: After assisting WAJ/GOJ in addressing and resolving the level of cost recovery and other policies to be established under Item 1 above, the foundation will be laid for AID to enter into further discussions with WAJ/GOJ concerning tariffs. There is a likely need to increase the tariffs to provide increased revenues, at least in the urban areas. The Tariff Study (Black and Veatch) failed to provide the basis for an analysis of policy options (e.g., the ability to review "what if" scenarios) which could be undertaken within GOJ's decision-making processes to allow for closures and implementation.

Water Loss Reduction and Revenue Systems Improvements Must Accompany, If Not Precede, Tariff Adjustments: The need for improvement in revenue systems and the reduction of non-revenue water should have been given greater emphasis in past dialogue between AID and ASJ/GOJ. AID funding support for such improvements would have helped improve WAJ's financial position as well as enhanced the opportunities for achieving tariff increases.

Design and Implementation of Institutional and Systems Improvements Require Long-Term Technical Assistance Inputs: The ongoing project for technical assistance in training and institution building being provided the CH2MHill, JMM and Associates team is on target. It is, however, already clear that additional inputs far beyond the current 24 month period will be needed. For example the 12 man-months provided for the financial specialist can only provide the initial steps. This specialist will guide WAJ toward the design and GOJ acceptance of a commercially based utility accounting system, providing appropriate interfaces with the prescribed governmental budgeting, accounting, and financial control systems that WAJ must comply with. Detailed design of procedures manuals, including forms and reports, translations into Arabic, staff training, and decentralized implementation and phase-in efforts followed by debugging, will almost certainly require much longer than 12 months.

WAJ Functions Vis-a-Vis the Ministerial Organization: WAJ currently includes some functions that are not strictly related to municipal and industrial water and wastewater services (e.g., water resources and irrigation). It would seem appropriate for action to be taken to transfer these functions to other units within the new Ministry of Water and Irrigation. In any event, the costs of these functions need not be included in cost recovery analyses for municipal and industrial water supply services.

Financial Policies To Enhance Sewer Connections: WAJ appears to lack a clear policy that is understood at decentralized locations concerning measures which can be employed to assist in the financing of sewer connections, such as extended payment periods (installment plans). Although past studies showed that this may not be an impediment to low-income households per se, current indications are that it could be a useful tool in speeding connections for multi-family units and other premises where sewer connection fees are high.

4.2 Training, Operations, and Maintenance

Training

The GOJ like most developing countries has placed a premium on U.S.-based training. It is probable that greater cost effectiveness and more immediately useful skills could be obtained from in-country training. This is especially true for an O&M instructor who could be brought from the United States to train in process control once a facility is on line. This approach would also allow a refocusing of emphasis from targeting engineers to directing the training towards greater numbers of technicians.

Three important lessons AID has learned from its training interventions in the water sector are (1) more emphasis needs to be placed on the mid-level employees, (2) course designs and scheduling should reflect a more "hands-on" approach (courses need to be scheduled more frequently and away from peak work periods), and (3) more emphasis needs to be placed on areas such as financial and personnel management and energy conservation. To enhance the learning

process, courses should be more interactive with students required to prepare course critiques to share with their colleagues. Course evaluations by TA's and WAJ personnel must become an integral part of the course design and redesign process.

Operations

No single lesson learned has been more apparent—or more easily correctable—than the lack of standard operating procedures (SOPs). AID should encourage WAJ, in as forceful a way as possible, to develop written SOPs for each water/wastewater plant. Specifically, the SOPs should include detailed action plans (i.e., process set-up, lab-based chemical inputs, etc.), and basic parameters and ranges (i.e., COD, BOD, SS, etc.) should be generated for each plant.

Maintenance

A centrally based standardized maintenance system/MIS (Management Information System) should be developed for better cost accounting and inventory control. The centrally based approach would allow for warehousing of expensive (as well as inexpensive) spare parts.

One concept that needs to be reinforced in the Kingdom is preventive maintenance. A single starting point would be to flush the collection systems prior to placing a plant on line. This would allow the system to be purged of septic sludges, as well as aiding the contractor in equipment testing prior to start up.

4.3 Design and Construction

GOJ has been successful in establishing acceptance of the concept of re-use of treated wastewater and, with the assistance of AID and other donors, has embarked on an ambitious program of development works to increase the level of wastewater services to urban areas and the availability of treated wastewater for controlled agricultural use (section 3.1.3). The selection of wastewater treatment processes and the design of facilities has been the responsibility of WAJ. The design of some aspects of these facilities may not have been optimal in all cases (for example, the Irbid wastewater treatment plant), particularly for effective operation and control under conditions in Jordan. In the case of the Irbid plant, the process could have been simplified, particularly by exclusion of the sludge digestion stage.

Similar comments apply to one of the two water treatment plants that were recently constructed. The Zai water treatment plant depends on complex automation of the treatment process and incorporates a sophisticated instrumentation system. The instrumentation system requires continuous maintenance and calibration by highly trained and dedicated personnel. An equally effective plant could have been designed incorporating simpler manual systems of operation and control.

Questions are also being raised regarding pipe materials for water and wastewater. Extensive wastewater collection systems and distribution system extensions and renovations have been and are being carried out. Some of the basic materials used in these works is questionable. Recent studies by consultants assigned by WAJ¹ have revealed rapid and extensive deterioration of galvanized steel and plain steel pipes used throughout water distribution systems (Section 5.1). In the Municipality of Amman, about 50 percent of the pipes are steel and the remainder are ductile iron and PVC. Deterioration of the steel pipes is particularly noticeable in pipes used prior to about 1980 when concrete lined steel pipes were introduced. Rapid deterioration of galvanized steel service connections has also been observed. Normal practice throughout the water industry is to use ductile iron pipes for distribution mains ranging in size from 70 mm to 500 mm and to use polyethylene (or other forms of plastic) for smaller diameter pipes used for service connections. The life of ductile iron pipes exceeds 50 years under most working conditions.

Regarding wastewater collection systems, a common phenomenon, particularly in areas having warmer climates, is corrosive attack of the internal surfaces of sewers by the products of hydrogen sulfide. This condition occurs where sewers run partially full and where wastes are retained in the system for long periods of time. It is probable that the locally manufactured cast concrete pipes used in the construction in Jordan would be susceptible to this form of deterioration, particularly in the earlier life of the system before flows have fully developed; the relatively small quantities of water used in Jordan may also increase the probability of pipe deterioration.

As far as was ascertained during this study, there has been no research of this subject in Jordan and measures to protect sewer pipes have not been introduced.

On a more positive note, there have been substantial improvements in procurement procedures in WAJ primarily resulting from influence by foreign donors and from experience gained in working with foreign engineering consultants. In this connection, closer specifications for equipment, materials, and construction services have helped to exclude some inferior quality items. Overall, the quality of design and construction observed during this study has by far exceeded that of other developing countries.

¹Hydraulic Analysis of the Water System in the Greater Amman Area. Sogreah, Jouzy & Partners Consulting Engineering Bureau and WCS Operations Management.

Chapter 5

POLICY ISSUES

In some instances, the course of AID's future participation in the water sector of Jordan seems clear based on past experience and current needs. In other cases, policy issues exist which must be addressed and resolved as a basis for establishing the most appropriate course of action for AID.

5.1 Role of the Private Sector in Operations and Maintenance

WAJ is the agency responsible for the provision of water supply and wastewater services throughout the Kingdom except for certain responsibilities, primarily concerned with irrigation, which are under the authority of JVA. The estimated total population of the Kingdom in 1985 was 2.7 million, of which almost 90 percent received piped water, the remainder being served by tankers or private wells. About 30 percent of the population in 1985 were connected to piped wastewater systems, although since that date a number of new piped wastewater systems have been completed. Water treatment plants and wastewater treatment plants in operation and recently completed are shown in Table 7.

As part of its responsibilities for operation and maintenance of water and wastewater treatment plants, WAJ also operates and maintains water source works, transmission systems, water distribution systems, wastewater collection networks, and metering systems to measure both the quantity of water produced at source and the quantity reaching consumers. An impression of the magnitude of these maintenance tasks and the level of day-to-day activity is conveyed by the following randomly chosen statistics:

- ♦ In 1986, there were almost 360,000 metered water connections in the Kingdom.
- ♦ In the Greater Amman area alone the total length of water mains in sizes ranging from 50 to 1,000 mm is almost 2,000 km.
- ♦ The total number of repairs recorded by GOJ in response to complaints of failures in the distribution system in the Greater Amman area in 1985, '86, and '87 were 33,000, 62,000, and 52,000 respectively (numbers are rounded to the nearest 1,000).

To meet its many obligations in both operation and maintenance of the vast networks providing water and wastewater services throughout the country, and implementation of a large program of capital works, WAJ employs almost 5,000 staff, of which some 50 percent are reported to be engaged in operation and maintenance (Appendix B).

Table 7
Water and Wastewater Treatment Facilities

June 1988

FACILITY	APPROXIMATE DESIGN CAPACITY M ³ /D	TYPE OF PLANT/TREATMENT STAGES
<u>Water Treatment</u>		
Zai Water Treatment Plant	125,000	Coagulation - flocculation - sedimentation - filtration
Irbid Water Treatment	20,000	Aeration - coagulation - filtration
<u>Wastewater Treatment</u>		
Al-Samra	70,000	Waste Stabilization ponds
Central Irbid	12,000*	Trickling filter - activated sludge
Salt	3,000	Extended aeration (mechanical aerators).
Jarash	600	Oxidation ditch
Aqaba	9,000*	Waste stabilization ponds
Baq'a	6,000*	Trickling filter - solids contract
Ramtha	2,300*	Waste Stabilization ponds
Mafrq	1,800*	Waste Stabilization ponds
Al-Karak	800*	Imhoff tank - trickling filter
Madaba	2,000*	Waste Stabilization ponds
Ma'an	1,200*	Waste Stabilization ponds
Kafranjeh	1,800*	Imhoff tank - two-stage trickling filters
Tafileh	1,600*	Imhoff tank - trickling filter

* Plants recently completed or to be completed and brought into operation in 1988.

Although the private sector has a substantial role in assisting WAJ to implement its capital development program—through consulting and contracting services for engineering design, supervision of construction, construction and start-up of facilities, and operator training—operation and maintenance functions have been implemented almost entirely by WAJ staff without assistance from the private sector. Recently, policy level discussions have taken place regarding possible involvement of the private sector in discrete operation and maintenance tasks, but as yet no firm policy directive has resulted from these discussions.

A discussion of privatization in Chapter 7 identifies some of the methods that could be applied in Jordan and certain of the advantages and disadvantages of the privatization process that may result from such application. To achieve maximum success from delegating certain functions to the private sector it is necessary to select those functions for which the public has limited capacity or capability and the private sector has traditionally high levels of success and ability. Satisfying these criteria, there are two primary areas which are directly related to WAJ operation and maintenance responsibilities namely: the operation and maintenance of certain wastewater and water treatment plants; and metering, billing, and collection of water and wastewater charges. Each of these activities is discussed below in relation to potential involvement of the private sector.

Wastewater treatment and water treatment are relatively new responsibilities for WAJ. Both of the water treatment plants have been brought into operation within the past two years and, with the exception of the Ain Ghazal plant, much of which is now disused, all of the wastewater treatment plants (Table 7) have either been very recently completed or are not yet operational. New wastewater treatment plants at Naur, Fuheis, and Sukhna are also to be constructed. Despite serious efforts on the part of WAJ and the various international financial assistance agencies to provide suitable training opportunities, there are few trained staff capable of reliably operating these facilities and even fewer experienced engineers and technicians. The difficulty is compounded by the complexity of certain plants and the broad range of skills that is required, including mechanical, electrical, instrumentation, and both biological and chemical processes. Such skills are essential for effective operation of many of the plants.

The type of predicament in which WAJ is placed in relation to plant operation is illustrated by a brief review of the Zai water treatment plant. The plant has a nominal design capacity of 125,000 cubic meters per day and receives intermittent supplies of varying quantity and quality of raw water from the King Abdullah Canal. The plant is designed to deliver potable water of a consistent quality to Amman via a distribution reservoir. Because of variations in the quality of water at source, the plant is designed to offer a broad range of treatment alternatives comprising some eleven chemical treatment options. Furthermore, a high degree of remote control and automation has been incorporated in the design requiring sophisticated instrumentation. The plant is equipped with a laboratory, staffed by competent WAJ personnel, to monitor raw water quality, identify optimum water treatment processes, and monitor water quality throughout the five main treatment stages throughout the 24-hour operation period. The plant also monitors the quality of water supplied to Amman consumers. Because of lack of

experience, staff are not consistently able to quickly identify appropriate and optimum treatment requirements for a particular type of raw water that may be encountered. Plant operation is made less reliable by a shortage of skilled manpower to constantly check and adjust the calibration of the complex instrumentation system and to maintain the system in good working order. Such maintenance requires access to replacement parts through a fast and reliable line of communication which does not exist through Government channels. Furthermore, the varying quality in the electrical supply contributes to the difficulties in maintaining delicate instruments in working order. Maintenance difficulties are exacerbated by intermittent plant operation. Maintenance of adequate stocks and supplies of chemicals (chlorine, potassium permanganate, activated carbon, poly-electrolytes, aluminum sulfate, and caustic soda) has proved to be difficult, possibly because of lengthy procurement procedures and customs clearance delays.

Various strategies to overcome these difficulties are being considered by WAJ, one of which involves large capital investment to bring water of a more consistent quality to the plant from a more distant source. This would clearly be inappropriate since the plant has been designed and constructed to treat KAC water and would do so with the utmost reliability if properly operated and maintained. Although WAJ staff could be trained to operate the plant, the process would take time and at the end of it the staff would still be inexperienced. It is also likely that competent staff would be lured away by this private sector. Furthermore, the allied difficulties in supplies of parts, chemicals, etc. would not be resolved by this means. Operation and maintenance of the plant by the private sector under a "contracting-out" arrangement (Chapter 7) would appear to be an ideal solution. The selected contractor (ideally a consortium including expatriate and Jordanian personnel) would be responsible for all aspects of plant operation and maintenance, including the purchase of chemicals, replacement parts, labor and energy costs etc. and would receive payment for the quantity of water treated to standards set and monitored by WAJ. A minimum quantity of raw water to be made available would form part of the contract. In this way, operating costs would be minimized and water quality standards could be maintained at a high level. Careful study of requirements prior to preparation of bid documents (including prequalification of bidders) would be an essential preliminary to such a contract.

Transfer of operation and maintenance responsibilities for some of the larger and more complex wastewater treatment systems to the private sector also warrants consideration. It would resolve the major operational difficulties in the immediate future. This would also provide an opportunity to increase the level of expertise in Jordanian firms in this field. A suitable plant would include Central Irbid wastewater treatment plant, possibly Irbid water treatment plant and other plants (excluding waste stabilization ponds) with which difficulties of operation are encountered.

The second area identified as meeting the criteria for private sector participation is that of metering, billing, and revenue collection. Improved performance in this area is one of WAJ's higher priorities in view of the large loss of revenue resulting from the performance under the present system

(Chapter 2). Deficiencies in the present system of metering, billing, and collection are categorized under the following headings:

- ♦ Under-registration of subscribers' meters
- ♦ Defects in source meters
- ♦ Errors in reading subscribers' meters and billing
- ♦ Illegal connections
- ♦ Leakage.

WAJ has recently carried out a detailed study of unaccounted for water and has devised an action plan to resolve these difficulties. The plan is divided into an "immediate" phase and a "long-term" phase. The plan is commendable; it is based on a thorough examination of the present technical and administrative difficulties and it proposes practical solutions, although the time frame in which it is to be implemented may prove to be optimistic.

The private sector, if given the responsibility of the metering and billing process, would have several advantages over the public sector in restoring the process to a level of acceptable efficiency. These advantages would include: experience in resolving similar issues in other areas, particularly in selection of meters; compiling accurate registers of consumers; organizing meter testing repair and calibration facilities with associated records systems; establishing reliable meter reading and billing procedures and obtaining meter reading staff. In addition, the private sector would be able to offer incentives to attract experienced and specialized management and staff and would generally have greater flexibility in all areas of its operation.

In view of the urgency and importance of this program to reduce unaccounted for water, it is recommended that consideration be given to establishing, in parallel with WAJ's action program, a program for a separate area within Greater Amman where a carefully prepared plan would be implemented. Under such a plan a contract would be awarded to a private firm or consortium, to implement all or parts of the metering, billing, collection, and leakage control activities in a prescribed area. As previously noted, incentives might also be offered for decreasing the levels of unaccounted for water on the basis of making part of contract payments proportional to the difference between water supplied to the contract area compared with water sold.

Variations in the degree of privatization are feasible. Referring to the categories of deficiencies listed above, the greatest revenue losses are reported by WAJ to be caused by under-registration of meters. There would therefore appear to be some justification for privatizing only the meter replacement and repair activities, and this would indeed relieve WAJ of a tremendous burden and enable improvements to be more rapidly realized. Such a plan would, however, lose the incentives that could be offered in a contract for a package, including the very closely associated function of meter

reading. Billing and collection could be excluded from the contract and performed centrally although the present difficulties and delays in transposing readings to billings would probably remain unresolved. Given the pros and cons, one would conclude that it would be much more advantageous to include all operations in a contract for a pilot area.

The existing surplus of WAJ personnel, and the small percentage increase in this surplus that privatization may create, would be dealt with by attrition and a strict freeze on hiring.

5.2 Re-use of Treated Wastewater

The principle of re-use of wastewater treatment plant effluent for irrigation has been accepted in Jordan. The GOJ, in consultation with WAJ and JVA, recognized the need to conserve water as a scarce and valuable resource. In the late 1970s, the GOJ made a conscious decision to develop wastewater collection and treatment facilities capable of providing effluent of a quality suitable for restricted agricultural use. In areas unsuitable for agriculture, the aim was to produce effluents environmentally suitable for safe discharge into river beds or wadis, many of which are dry for most of the year. The wastewater treatment plants listed in Table 7, many of which formed part of AID-assisted projects, were designed to meet these criteria. In arid and semi-arid countries there is a high potential for wastewater re-use and the use of treated effluent for certain types of agriculture, most notably those which do not require high quality water. This approach conserves the better quality sources of water, in this case groundwater, for domestic and industrial use.

The re-use of treated wastewater is limited by economic considerations. In order to concentrate municipal wastewater in quantities sufficient to warrant treatment for re-use, there must first be an adequate piped water supply system. Wastewater in sufficient quantities for economical re-use is, therefore, only available from the larger urban centers which have invested considerable capital expenditure in construction and operation of both a piped water supply and a piped wastewater collection and treatment system. Wastewater quality may preclude re-use of treated effluent in cases where certain industrial wastes (primarily those containing heavy metals such as cadmium, chromium, copper, lead, nickel, and zinc) are discharged untreated to the wastewater collection system. Boron is also a potentially harmful toxic element present in domestic wastewater originating from washing powders. Some crops absorb heavy metals from solids and their growth may be inhibited. Tolerance of various crops to the various elements found in treated effluent has been widely researched and extensive data and guidelines on the subject are readily available.

In addition to toxic chemicals, some biological constituents in wastewater may be potentially harmful to health. Treatment processes are designed to control such organisms to levels prescribed in international and other standards for re-use of treated effluents for agriculture.

Water use for agriculture throughout the Kingdom has increased steadily since the 1960s and irrigated agriculture now covers 48,000 ha in the Jordan Valley and uplands. These areas use an estimated 76 percent of water consumed in the Kingdom (World Bank, Jordan Water Resources Sector Study, 1988). Municipal and industrial water needs have increased sharply and will continue to do so as a result of rising incomes and increasing population and urbanization levels. As water demands increase there will be a substantial increase in water re-use. The surveillance of wastewater treatment operations, the quality of plant effluents, and strict monitoring of industrial waste discharges will assume increasing importance to protect health and the environment in the future. In north Jordan this factor is even now assuming primary importance where six cities, Amman, Zarqa, Ruseifa, Irbid, Jerash, and Salt, have wastewater collection systems and where four wastewater water treatment plants are in operation. Most of the effluent from the Al Samra ponds and the effluent from the Salt and Jerash plants are discharged to the Zarqa river and then to the King Talal Reservoir for irrigation re-use. Effluent from the Irbid plant is used for irrigation after dilution and storage in the Wadi Arab Reservoir.

5.3 Collection and Treatment of Industrial Wastewater

Wastewater is a mixture of domestic and industrial wastes containing constituents in four broad categories:

- ♦ Water—the major component
- ♦ Biodegradable matter, which can be broken down by bacteria during the normal plant process, and solid matter.
- ♦ Other materials which cause damage to the wastewater system and increase costs of conveyance and treatment.
- ♦ Materials, including toxic materials, which are not removed by sewage purification process.

Normal policy in industrialized countries is to accept the biodegradable and solid constituents for discharge to sewers but to limit acceptance of toxic and other polluting materials. This policy is designed to protect maintenance personnel, the wastewater system, the treatment process, and the receiving waters into which the effluent is discharged. In the event of re-use of effluent this policy is designed to safeguard the users, promote the growth of selected crops, and prevent deterioration of the soil. Throughout industrial countries the range and magnitude of potentially harmful effects of wastes from industry have increased in recent years, and standards specifying acceptable characteristics and concentrations of waste components for discharge to sewers are under constant review. An important factor is that, although industry may contribute only a small percentage of the total volume of wastewater, it may present a very large portion of the polluting matter (or BOD) treated at the plant. Industrial wastes can represent a large part of the cost of treatment, and the charging and acceptance policy for industrial wastes should be designed to provide for this factor.

In Jordan the policy described above has generally been accepted and legislation has been enacted to prevent discharge of industrial wastes to the environment; regulations regarding industrial waste discharges are at present being revised. The responsibility for monitoring industrial waste discharges rests with WAJ. The Ministry of Municipalities, Rural Affairs and the Environment also has responsibilities in this connection. This Ministry has commissioned the Royal Scientific Society to monitor industrial waste discharges to the Zarqa River. Although sampling is regular it is, however, infrequent. The magnitude of the industrial waste question in Jordan still appears to be within reasonable limits.

Most industry is concentrated in the Zarqa area where there are some 25 to 30 firms each employing more than 20 people. Of this total, the wastes from some 22 are monitored, some seven of which discharge potentially toxic materials. None, however, are discharged to the wastewater system. Some of these industries operate their own waste treatment systems with varying degrees of effectiveness.

Although the extent of industrialization in the Kingdom is still quite minor and industrial pollution is not yet a major issue, projected industrial development indicates a two-fold increase in water used for industry in the next ten years, and a four-fold increase by the year 2015. There is clearly no reason for complacency. Development of programs for effective control and monitoring of industrial waste discharges as well as controls for groundwater withdrawals by industry should receive priority. Given the overall scarcity of water and its importance to Jordan's economy, it is essential that judicious use be made of all resources. It is important that potential re-use wastewater is protected from harmful contamination by industry. Some of the typical steps towards the development of a program to review industrial waste controls should include:

- ♦ Review and updating of trade wastes legislation
- ♦ Establishment of acceptable levels of physical and chemical waste parameters
- ♦ Identification of a single agency responsible for monitoring waste discharges and administering the regulations.
- ♦ A comprehensive scale of charges based on waste composition, strengths, and quantities.
- ♦ Establishment of methods and frequency of sampling.
- ♦ Identification of penalties for noncompliance.

Consultants might be usefully employed to implement preparatory items for such a program. Administrative and budgeting provisions would also need to be addressed. Ideally routine monitoring tasks would be carried out by a private laboratory under close surveillance of the public sector agency.

5.4 Institutional and Financial Strengthening

WAJ's Rural Clientele: Now that there is a mix of urban, suburban and rural subscribers, the question arises as to whether or not differentiations should be made between these areas with respect to (i) the level of service to be provided, (ii) the proportion of cost recovery (or subsidy) to be established, and (iii) the identification of cost items to be included in calculating (ii) above. For example, should debt service for urban improvements be included in the cost recovery calculations for rural subscribers?

Subsidy in Support of New Wastewater Systems: AID should consider promoting the idea that GOJ should pass through the soft loan terms (made available by AID to GOJ) to WAJ for wastewater projects. Consideration might also be given to the same policy for other donors, where the GOJ has not passed through soft lending terms. A moratorium could also be considered to allow time for wastewater revenues to grow to the required level.

Cost Recovery and Pricing Policy: The policy question again relates to whether or not there should be differentiation in tariffs between Amman and other areas in the Kingdom as provided in the current tariff schedule. Across the board, basically uniform tariffs throughout the Kingdom as suggested by BVI may not be feasible. It may be appropriate to simply recognize that some subsidization of rural water service will be needed. Alternatively, greater degrees of cross-subsidization could be established between types of consumers (e.g., higher differentials for commercial and industrial users) than has been included in current tariffs or recommended by BVI. AID could consider offering to fund a sequel to the BVI Report to establish a computer model for analyzing alternative tariff policies. Such a model would also have application in helping WAJ strengthen its overall financial management and planning capabilities.

Water Loss Reduction and Revenue Systems Improvements: Strong central government support is needed in order for WAJ to achieve success in these areas. AID should consider offering funding support for existing WAJ plans, but only after receiving assurances that firm central government policy support will be provided as the improvement programs are implemented.

Revolving Fund For New Connections: On the assumption the appropriate legal clearances can be obtained, AID should consider establishing a revolving fund which would permit new connection costs to be paid on an installment plan. This would assist WAJ in financing these costs without further burdening its limited financial resources, while at the same time speeding the rate of connections to the various wastewater systems.

Longer Term Technical Assistance in Institution Building: The water sector is now consolidated within a single ministry. The newly appointed minister, however, has yet to be provided with the organization, staff and supporting services that will permit him to function effectively at the cabinet level

where, representing a truly unified sector, he will be expected to speak with authority concerning the major issues such as allocation of water resources, water quality, and environmental impact. Having accepted the responsibility for one of the country's most critical sectors, the minister must establish himself as the central policy figure. If the minister is to be successful, he will need to resist the temptation to dissipate his energies by involving himself in the operational aspects of the sector. The minister should delegate downward operational responsibilities and move expeditiously to consolidate the policy making apparatus at his level.

Initial organization planning for ministerial level functions is being provided through consultants assigned to WAJ. Since WAJ has vested interests in the ultimate outcome of the ministry's organization structure, AID should consider steps that could be taken to assure that the minister is provided with purely objective advice. This should aid in achieving divestiture of the irrigation and water resources functions from WAJ as well as providing the minister with the resources and management systems needed to achieve the objectives of water sector consolidation.

One possible approach would be for AID to offer to fund the expansion of the existing CH2MHill project. This could be made conditional on the transfer of reporting responsibility from WAJ to the minister. In addition to lengthened and expanded consulting inputs to meet WAJ's needs, the project scope could be further expanded to provide specialist support for the minister and the other functions in the ministry. Some of the functional areas of expertise to be provided are:

- ♦ irrigation engineering
- ♦ water resources management
- ♦ development economics
- ♦ public policy analysis

The provision for short-term specialists could also be expanded to meet additional requirements of the Minister. If it is determined that long-term advisors are required in such areas, it may be preferable to provide them through personal services contracts rather than through the consulting contract. This approach, however, should be undertaken in concert with the establishment of a policy group of ministerial staff team. Simply providing one long-term advisor would signal acquiescence to the jack-of-all-trades concept and would likely find its value as instructive of how things ought not to be done.

Chapter 6

RECOMMENDATIONS

Recommendations emanating from the assessment are organized under five main headings: institutional, operations and maintenance, training, tariffs and regulatory/policy reforms. In those instances where AID funding support is suggested, rough estimates of cost are provided. These can be considered as indicative of likely cost ranges but would need substantial refinement prior to incorporation in formal funding requests. The recommendations have been bulleted to reflect conclusions drawn from materials presented in the text of the report. At the end of the recommendations is a section on general observations and constraints which are intended to assist AID management with setting priorities.

6.1 Institutional Management

Support Institution Building for the Ministry and WAJ:

- ♦ Enter into discussions with the minister to confirm his requirement for senior consulting/advisory assistance in bringing his ministry up to full operational status.
- ♦ Offer to provide U.S. consultants/advisors.
- ♦ Suggest that the current CH2MHill project be expanded to meet a portion of his needs and that the team's reporting responsibility be transferred to him.
- ♦ Suggest ministerial-level advisors as a minimum in the areas of irrigation engineering, water resources management, development economics, and public policy analysis and occasional short-term specialists as needed; elicit his ideas concerning options and negotiate; approximately 100 person-months would be required.
- ♦ Determine optimum administrative arrangements (personal services contracts vs. consultants).
- ♦ WAJ will likely request expansion of the CH2MHill project; AID should support this with a minimum two-year extension (to 1991) and expansion of the expatriate man-month input by approximately 60 person-months; local consultant input should be determined but would likely be an equal amount.

A three-year package encompassing the above is estimated to cost US \$2,350,000. Assumptions and a detailed cost breakdown are shown in Appendix C.

6.2 Operations and Maintenance

- ♦ Standard operating procedures (SOPs) should be written for all water/wastewater plants. They should also be made part of the O&M manuals for new and existing plants.
- ♦ Basic parameters (BOD5, SS, COD, etc.) should be generated for the various plants and should be included in the O&M manuals for plant use and also in the training course.
- ♦ A maintenance management system should be generated for greater spare parts control and cost accounting.
- ♦ A study should be undertaken to determine if it is feasible and cost effective to operate the Zai water treatment plant as a contract operations.

6.3 Training

- ♦ More hands-on training, especially on process control should be stressed. In-house (plant/work site) training should be developed.
- ♦ Financial and management courses should be given to mid-level supervisors.
- ♦ A greater variety and number of video tapes should be made available, i.e., maintenance, water pollution control federation series on different types of treatment processes. This would allow for more self-help training.
- ♦ Feedback/course evaluation forms should be developed and used in future training programs.
- ♦ A cadre of qualified trainers should be developed from all agencies that conduct training.
- ♦ An orientation program should be developed for new employees. It should include benefits available, job descriptions, SOPs, table of organization, and support services available.
- ♦ A study should be conducted to determine if it is feasible and cost effective to use the old Ain Ghazal wastewater plant as a hands-on training facility. This study should also examine Ain Ghazal use for other vocational/technical schools.
- ♦ A licensing program for personnel in the water/wastewater field should be instituted. This would upgrade personnel into the professional ranks and could be a possible incentive for advancement and salary increases.

6.4 Water and Wastewater Tariffs

Encourage and Support Tariff Increases as Part of a Comprehensive Program of Revenue Enhancements:

- ♦ Suggest establishment of a Working Group on revenue enhancements, including AID representation (this assumes AID financial support outlined below), which would meet on a scheduled basis (quarterly) to review and report to the minister concerning progress in revenue enhancement efforts; in addition to the AID representative, appointees to the Working Group could include the Secretary General of WAJ, the Chief Administrator for Financial and Administrative Affairs of WAJ, the Chief Administrator for Planning, Development and Information of WAJ and representatives of the Ministry of Finance and the Ministry of Planning.
- ♦ Offer financial support for an integrated revenue enhancement program consisting of water loss reductions and revenue systems improvements (based on an AID review and refinement of WAJ's Action Plan) and tariff increases; AID financing assistance would be contingent upon firm and articulated support for the unpopular, but necessary elements of the program, such as customer disconnections for nonpayment and curtailment of negotiated bill reductions; cost containment and reductions would also be included in the scope of the Working Group; reductions would be sought for example, through the divestment of irrigation and water resources functions to other units in the ministry and improvements in operating efficiency; temporary debt service relief would also be considered (see below).
- ♦ Systematically approach the basic policy issues which should be resolved prior to setting tariffs; consider the urban and rural subscriber groups and determine whether tariffs should be uniform for all subscribers or whether levels of service or ability to pay should be considered; evaluate the advantages and disadvantages of establishing individual tariff schedules to recover investment and debt service costs for individual communities, based on investments made in those communities rather than spreading the cost recovery burdens Kingdom-wide; also consider whether or not commercial and industrial subscribers should be charged at a higher differential in comparison with tariffs charged to domestic subscribers for comparable levels of consumption.
- ♦ Promote the pass-through to WAJ, at least on a temporary basis (e.g., 10 years), of AID lending terms; ideally, this would be accomplished for all AID loans in the sector; as a minimum, it should be done for the debt service on loans for wastewater systems; encourage the Working Group to review other relending agreements for loans made by other donors to determine if additional temporary debt service relief might be available.

- ♦ Begin the tariff setting process after the Working Group has established the basic agreed upon cost recovery and pricing policies and a realistic schedule for achieving water loss reductions has been developed. Provide funding assistance for the development of a computer model for analysis of optional tariff plans and schedules. The model should be capable of incorporating any of the optional cost recovery plans and also serve as an overall financial planning tool. About four person-months of expatriate consulting assistance and a counterpart local consultant for an equal input would be required to develop the model and train WAJ staff in its use. WAJ staff for this purpose should be selected from (or assigned to) the Directorate of Planning and Development.
- ♦ Support the gradual phasing-in of the revised tariff plan over a period of say, two years. At the end of the phase-in period, the tariffs should be sufficiently high to avoid annual increases. Tariff should be set so as to require adjustment no more frequently than each three to five years.
- ♦ Promote the establishment of a revolving fund for use in financing the payment of sewer connections on an installment plan basis. If necessary, offer to provide financial support for the establishment of the fund. There is little information upon which to estimate the monetary requirement for this purpose but a seed fund of US \$150,000 would seem adequate to provide assurances that sewer connection fees are not constraining the rate of sewer connections.

The estimated cost of AID support for the foregoing activities over a period of three years is US \$6,000,000. This represents an approximation of the total hardware and training requirements contained in WAJ's Action Plan for water loss reduction, plus the US \$150,000 in seed money for the proposed sewer connection revolving fund. Assumptions and details are presented in Appendix C.

6.5 Regulatory and Policy Reforms

Regulatory and policy reforms are summarized below and each is then discussed in more detail. In summary, it is recommended that:

- ♦ AID assist GOJ and WAJ to establish an independent standing committee to review all economic and technical proposals relating to WAJ's development plans and operation and maintenance activities.
- ♦ AID assist and support GOJ and WAJ in involvement of the private sector in those activities in which the private sector has a substantial relative advantage over the public sector, namely 1) operation and maintenance of selected water and wastewater facilities and 2) parts of the water metering, billing, and collection of revenue.

- ♦ AID assist GOJ to properly protect water quality and the environment by establishing a program for industrial waste monitoring, supported by legislation and regulations applicable to Jordan.
- ♦ AID continue to assist WAJ to implement selected infrastructure and development projects.
- ♦ AID assist the development of private industry to provide items required in development operation and maintenance of the water and wastewater sector in Jordan and abroad.

Factors regarding the effectiveness of design and construction were addressed in Section 4.3 where it was noted that, with few exceptions, the standards maintained by WAJ as a result of influence by experienced and highly competent consulting engineers over the past decade or so are exceptional. In several areas there are opportunities for further improvements, but these would best be introduced at the policy planning level rather than direct changes to design or construction.

A policy issue is whether, with AID assistance, GOJ and WAJ could be encouraged to safeguard future investments in infrastructure by establishing an independent technical review committee comprised of a representative from the office of the Minister of Water and Irrigation, WAJ personnel, experts from RSS, and the private sector to review technical proposals (master plans, feasibility studies, preliminary and final designs, selection of materials and equipment, large purchases, etc.). The advantages of such a system are self evident in the light of lessons learned with regard to selection of appropriate technology and materials. Safeguards would be needed to ensure that the members of such a committee are adequately qualified and experienced to make effective judgments on a broad range of issues. Furthermore, as with the imposition of any additional level of review and approval, a strict time frame for completion of the process would be essential to avoid delays in implementing more urgent components of the development program.

A further proposal concerning policy reform is that of involvement of the private sector in public sector activities, particularly those of WAJ. The advantages of various forms of privatization are discussed in Chapter 7. The difficulties experienced by WAJ in meeting its obligations to effectively operate and maintain water and wastewater treatment plants are discussed in Sections 3.1.3, 3.1.4; operation of facilities by the private sector are discussed in Section 5.1. In summary, it is clear that WAJ does not have staff who are sufficiently experienced and capable of reliably operating certain facilities. Furthermore, there are serious constraints to the recruitment, retention or training staff suitable for these functions, as discussed in other sections of this report. This report also discusses inherent difficulties in metering billing and collection procedures (Chapter 2) and advantages in "contracting out" some of these procedures (Sections 5.1 and 7.2).

Although WAJ has discussed the involvement of the private sector in these functions, a firm policy decision has not yet been reached. AID is therefore in a position to recommend to GOJ, and actively support, involvement of the private sector in activities in which the private sector has a high level of capability, namely 1) the operation and maintenance of the larger and more complex water and wastewater treatment plants and 2) parts of the water metering, billing and collection tasks, apportioned either geographically or functionally and beginning with a discrete pilot operation.

The final policy question concerns protection of water sources and the environment. The quality of water for both agriculture and municipal use is vulnerable to unanticipated sudden changes either from natural causes, intentional irresponsible dumping of wastes into water courses or catchments or by the discharge of industrial wastes to the environment or wastewater collection systems. An awareness of these possibilities was recently heightened by an incident in which below average quality water reached consumers (Section 3.1.3).

It would therefore be appropriate for AID to assist GOJ to properly protect water quality and the environment by establishing a program for industrial waste monitoring, which would include measures to:

- ♦ Review and update trade wastes legislation and monitoring
- ♦ Establish acceptable levels of physical and chemical waste parameters
- ♦ Identify a single agency responsible for monitoring trade waste discharges and administering the regulations
- ♦ Establish a comprehensive scale of charges based on waste composition, strengths and quantities
- ♦ Establish methods and frequency of sampling
- ♦ Identify methods of analysis
- ♦ Agree on suitable penalties for noncompliance with the regulations

In addition to studies and related activities arising from policy issues discussed above, there would be continued opportunities for AID assistance in infrastructure (or so-called "hardware") projects as well as possible opportunities to influence the private sector.

In infrastructure projects, WAJ very wisely places emphasis on the expansion of water and wastewater facilities to more fully utilize existing facilities. Other priority items include upgrading and modernizing well drilling equipment, groundwater investigations, and renovation of distribution systems. Planned expenditures in 1989 and 1990 in these activities amount to about JD 27 and 24 million, respectively.

Regarding privatized industry, there are indications that a change in water pipe materials used in Jordan, from galvanized steel to polyethylene (or similar) and from steel to ductile iron, will take place in the near future. Small diameter galvanized steel pipes (to be replaced by polyethylene) are manufactured in Jordan. It may be feasible to begin the manufacture of polyethylene pipes in Jordan if the establishment of such an industrial enterprise were initially assisted by a donor, such as AID. Manufacture of ductile iron pipes, on the other hand, is a more major task involving heavy industry and would not be a suitable industry to develop in Jordan.

Similarly, improvements in the local manufacture of concrete pipes for wastewater collection systems are required, in order to provide protection from corrosion. Again, assistance to Jordanian manufacturers would be needed.

Observations and Constraints

Clearly AID cannot and should not fund all the recommendations presented in this report. AID may want to take the lead in a donor meeting to discuss international participation. For example, it seems appropriate to encourage the GOJ to enter into a dialogue with Japan regarding aid in the form of ductile iron for replacement pipes.

We also think that the difficulty of working in the Jordan cultural-policy environment has been understated. This is especially true in the area of privatization. USAID may well wish to approach this issue as a continuum strategy, i.e., from public to semi-public to semi-private to private. For example, there is likely to be significant resistance by WAJ to privatizing functions which idle large numbers of government employees. While internal rates of return analysis may be intellectually persuasive, a more pragmatic approach may be required. USAID should consider the intermediate steps of encouraging WAJ to establish cost and profit centers, and progressing to establishing WAJ and JVA as bona fide parastatals en route to the complete privatization of operational functions.

USAID will also have to accept major short-term "leakage" in its training functions. It is clear that a major training program needs to continue in the water sector.

The reality is, however, that many of the trainees will find their way into more responsible GOJ positions or will opt for the greater rewards of the private sector. This is clearly inevitable in any society that is short of specific types of skilled manpower, and USAID's long-term strategy will have to take that into account. This is the generally unspoken down-side of promoting a shift toward greater private sector involvement in developing countries.

The final observation offered is that we believe the tendency of senior policy makers to involve themselves in mundane operational tasks will make USAID's work more difficult in Jordan. This is not an uncommon tendency in developing countries, and USAID will need to expend considerable energies to encourage the appropriate divisions between policy making and operations and maintenance categories.

Chapter 7

PRIVATIZATION AND THE PRIVATE SECTOR

7.1 Privatization - An Overview

The provision of piped water and, to a lesser extent, the collection and disposal of wastewater are services which traditionally have been almost entirely a public responsibility. In ancient civilizations water supply systems and drainage systems were invariably provided and operated by the public sector. More recently, particularly in Europe (notably in France) and the United States, private firms have been called upon to assume a more active role in certain public sector activities in roads, transportation, electric power, telecommunications and in the water and wastewater industry.

Private sector participation in an essentially public service or function is referred to as "privatization," a broad term used to describe several forms by which services may be produced or provided by the private sector. Two forms of privatization, which may be varied by degree and format to suit specific requirements, include (1) granting concessions to the private sector, such as an operating concession for facilities owned by the public authority or a construction and operation concession, for facilities financed by the (private) concessionaire; or (2) "contracting out" a service or function with the public authority retaining overall control and responsibility.

In the first case the public authority may contract a construction and operation "concession" to a single private operator who finances, constructs, and operates the facilities at his own risk. The contract contains a set of rules by which tariffs are calculated annually; these rules take into account a number of variables to allow the concessionaire to realize a return on investment. The concession contract also specifies the level of service (water quality, source, quantities for various public uses, and obligations to consumers). To allow amortization of investments, concession contracts are long-term, usually thirty years. At the end of the concession period the concessionaire must return the facilities to the public authority in acceptable condition.

In the second case the public authority constructs the system and contracts out the operation and maintenance, billing, and collection of charges. As in the previous case, tariffs are set by the public authority and include a surcharge payable to the contractor.

These systems are based on French privatization procedures (the concession and affermage systems) which have been successfully implemented in, and outside, France by a number of specialist water and wastewater firms. These systems form the basis of those now used in the United States, Spain, Canada, Japan and in some developing countries including the Ivory Coast (Abidjan).

An affermage contract in the Ivory Coast (which includes 122 towns and several hundred villages) has achieved extraordinary success. Under this system the government is responsible for planning and constructing all large new works

and a private French firm, under contract, is responsible for operation and maintenance in return for a fee related to the volume of water sold; the fee is calculated on a formula and indexed to inflation. Success of the system in the Ivory Coast is attributed to several factors including:

- ♦ Freedom of a private company to set incentives for its staff. This freedom plus a strong emphasis on training enables the company to attract, train and retain qualified people.
- ♦ Cost accounting (on a commercial basis) enables economies to be made as needed to keep tariffs down.
- ♦ Tariffs can be set to reflect total costs fully; no subsidies from the government are needed.
- ♦ Institutional separation of investments from operations allows operating performance to be clearly assessed and ensures control over system expansion.

The third form of privatization under which the public authority may contract out a service or function may include a variety of items of almost limitless scope, the more familiar of which are:

- ♦ operations and maintenance of water or wastewater treatment facilities;
- ♦ sampling and examination of water or wastewater;
- ♦ operation of stores and warehouses;
- ♦ operations and maintenance of water distribution or wastewater collection systems;
- ♦ water metering, billing, and collection of revenues.

Compensation of the private company for these services would normally be based on similar methods as those used for consulting services.

Experience elsewhere suggests that selection of the specific form and structure of privatization arrangements depend largely on local conditions and specific needs. Here, only a broad outline has been presented. Many shades and variations of these basic concepts may be devised to suit specific cases.

7.2 Privatization in Jordan

The decision to introduce privatization of service functions may be taken for a number of reasons: private firms may perform certain functions more effectively since they are able to offer more attractive terms to both staff and experts for whom government terms of service are not competitive; flexibility of operation in procurement of equipment and materials may be more readily achieved in the private sector; bonuses and incentives may be offered to staff or groups of operators as motivation to achieve certain goals; a higher level of technological expertise may be available in the private sector; or a combination of these factors.

Deficiencies in water and wastewater services are rarely due to technical factors but rather to ineffective management. Management by the private sector with the greater flexibility that it offers can bring results more quickly than attempts to improve public sector management practices. Furthermore, experience in other areas has shown that politically dominated administrations are unable to respect many of the operating principles necessary for successful management of some key functions of the system, particularly those requiring direct contact with consumers such as billing and collecting revenues and some aspects of controlling unaccounted for water.

In order to identify the extent to which the private sector could participate in the water supply and wastewater public sector, with significant advantages to the public sector, it is necessary to consider both the performance capability of the private sector in Jordan and functions which are at present performed by WAJ that have a potential for more effective implementation by the private sector.

At present, participation of the private sector in Jordan in water supply and sewerage is limited to the more traditional areas of:

- ♦ consulting services including feasibility and master plan studies and reports, engineering designs, construction supervision, and miscellaneous items such as organization studies, tariff studies, and training of WAJ staff;
- ♦ contracting services for construction, plant start-up, and operator training.
- ♦ contracting services for the supply of equipment and materials of both Jordanian and foreign manufacture.

These "contracted out" services are closely managed and monitored by WAJ.

In more recent years, considerable emphasis has been placed on enhancing the role of Jordanian consultants in the water supply and sewerage sector, and there are now several Jordanian firms capable of taking the lead in associations of firms engaged in planning, design, and construction of water and wastewater facilities. Similarly, the Jordanian construction industry can compete successfully in the sector, producing construction work of high quality.

In the event that opportunities occur for Jordanian consulting or construction firms to participate in the public sector under one of the three procedures described above, there are firms in Jordan which could do so effectively. However, in some cases association with foreign counterparts would be necessary to allow the Jordanian firms to gain experience in the field of operation selected for privatization. Much depends upon GOJ's policy regarding privatization of the public sector. It is understood that privatization of operation and maintenance of certain water treatment plants has been discussed as well as some aspects of metering, billing, and collection. Both of these activities would probably benefit from privatization as operating concessions for reasons stated at the beginning of this section. Under private management, treatment plant operations could be optimized resulting in financial savings; reliability of operation of complex treatment systems could be improved. Experience elsewhere suggests that metering, billing, and collection are more effectively managed in the private sector. This activity is reported to present the most serious difficulty at present faced by WAJ and has been allocated the highest priority for remedial action.

Emphasis should be placed on achieving a careful and rational approach to privatization. As a preliminary to privatization of any function, careful and detailed study coupled with pilot scale operations followed by analysis and evaluation of results are strongly recommended.

7.3 Private Sector Opportunities

Participation by the private sector in water supply and wastewater is at present concerned primarily with consultant and construction services and the manufacture and supply of equipment and materials.

In recognition of a need to strengthen the capability of private engineering consultants and construction firms in design, supervision of construction and construction of water supply and wastewater facilities, GOJ assisted by USAID embarked on a program aimed to improve technology transfer from foreign to local engineers and technicians beginning in the early 1980s. One of the most successful endeavors in this respect was the AID-funded Jordan Water Systems and Services Management Project (No. 278-0259) which contained components designed specifically to enhance technology transfer. In addition, in collaboration with GOJ, AID has designed and funded a series of projects to stimulate Jordanian private sector development in sectors other than water and wastewater.

As a result of the intensive capital development program in water and wastewater over the past decade and conscious efforts by the GOJ, AID, and other donor agencies, there now exists among Jordanian engineering consultants and construction contractors a capability to design and construct water and wastewater facilities to serve small and medium sized cities. The quality of these services is high where judged on an international scale and the services are technically competitive. Some Jordanian firms are reported to have successfully competed for work outside Jordan and it appears that financial rather than technical constraints limit more extensive participation of these firms in an international market.

Supply of equipment and materials to the sector is primarily from foreign manufacturers either directly or through local agents. Construction materials and equipment produced locally include cement, reinforcing steel for structural concrete, and pipes. Pipe manufacture comprises reinforced concrete pipes for wastewater collection systems, small quantities of PVC pressure pipes, relatively small quantities of glass reinforced plastic pipes, and galvanized steel pipes which are used extensively in the water systems for service connections and small diameter (up to 100 mm) distribution mains.

With the exception of cement and reinforcing steel, which are not limited to the water and wastewater sector, the scope for expanding the activities of these local manufacturers is questionable. Although there is a universal basic need for pipes, export of reinforced concrete pipes is seldom competitive because of high shipping and handling costs. The need for plastic pipes (both PVC and GRP) in Jordan is very limited because of adverse ground and pressure conditions, and these are no longer the most popular pipe materials overseas. Because of its strength and versatility, galvanized steel pipe has been used extensively in the past. However, it is subject to very rapid internal and external corrosion under most conditions encountered in the water industry and is being rapidly displaced by pipes of more durable material, primarily polyethylene (a flexible, thick walled plastic) or PVC for service connections and ductile iron for distribution mains.

There is, however, a continuing need in Jordan for water and wastewater related equipment and materials such as small diameter pipes (of acceptable materials), water meters, water storage tanks for domestic use, various types of valves, and chemicals for water and wastewater treatment. Although Jordan's needs are not large by international standards, they would form a stable base on which an export-oriented operation might be superimposed.

A further avenue for development of the private sector in the wastewater industry may well arise in connection with the potential increase in the discharge of industrial wastes by private industry. As yet there are few industries in Jordan and attention has only recently focused on the need to require industrial firms to treat industrial wastes prior to discharging them to the wastewater collection system or to the environment, to ensure compliance with predetermined water quality standards. Recent estimates¹ show that by year 2005 industrial water demand will increase by a factor of 2.4 over the 1985 figure. There is a potential for development of so called "package" plants, or more permanent facilities for the treatment of industrial wastes and an associated service industry to operate and maintain these facilities. As in the case of smaller items of manufactured goods discussed above, there is a potential for export, in this case both for the hardware and the operation and maintenance service.

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APPENDIX A

Typical Training Courses

Appendix A - Exhibit 1

Objectives for Pumping & Piping

1. Identify the pumping & pump unit
2. Describe the pumping & piping process
3. Describe the safety procedures for the pump & pumping unit
4. Identify the components of the pump & pumping units & how each works
5. Describe normal operating procedures for both units
6. Describe start-up & shut down procedures for both units
7. Describe emergency operation procedures for both units
8. Describe the preventative maintenance procedures for both units
9. Describe the differences between types of pumps & units

Appendix A - Exhibit 2

Objectives for Primary Sedimentation

1. Identify the Primary Sedimentation unit
2. Describe the Primary sedimentation process
3. Describe the safety procedures for the primary sedimentation unit
4. Identify the components of the primary sedimentation unit & how each unit works
5. Describe normal operating procedures for each component
6. Describe start-up & shut down procedures for each component
7. Describe emergency operation procedures for each component
8. Describe the preventative maintenance procedures for each component
9. Describe the differences between various types of sedimentation units.

APPENDIX B

**Water Authority of Jordan
Distribution of Present Staff**

APPENDIX B
Water Authority of Jordan
Distribution of Present Staff

ACTIVITY	DEPARTMENT	NUMBER OF STAFF
General	Personnel	17
	Administrative Services	7
	Archives and Filing	19
	Public Relations	6
	Follow-up	3
	Information Technology	12
	Training	10
Water Resources Irrigation	Water Resources Development	130
	Water Research and Studies	36
	Drilling	294
	Irrigation	147
Planning and Construction	Planning and Studies	66
	Tendering	24
	Construction of Projects	184
	Development and Improvement	2
Finance	Finance	283
Operations and Maintenance	O&M, Water Supply	2,825
	Wastewater	162
	Treatment Plants	115
	Laboratories	10
	Transport and Workshops	185
	Stores	97
	Secretary General	9
TOTAL		4,643

APPENDIX C

**Assumptions and Bases of Cost Estimates -
Jordan Water Sector Assessment Recommendations**

APPENDIX C

Assumptions and Bases of Cost Estimates Jordan Water Sector Assessment Recommendations

RECOMMENDATION	BASES OF COST ESTIMATES			
6.1 Support Institution Building for the Minister as well as for WAJ	<u>For the Minister</u>		<u>Personnel</u>	<u>Transportation</u>
	72 mm @ \$7,500/mm (personal services contracts)		\$540,000	13,200
	28 mm @ 14,000/mm (consultants including 4 mm for short-term)		392,000	13,200
	<u>For WAJ</u>			<u>Living Allowance</u>
	60 mm @ 12,500 (consultants)		750,000	22,000
	60 mm @ 4,000 (local consultants)		240,000	3,000
	Total = \$2,117,400		\$1,922,000	\$51,400
	10% contingency = 211,740			\$144,000
	\$2,329,140			say \$2,350,000
	Transp. (int'l) assumed at \$2,200 per R.T.; Avg. of 1 dependant for long term consultants. Living allowances assumed to average \$900 per month. Annual home leave included in transportation estimates.			
6.4 Encourage and Support Tariff Increases as Part of a Comprehensive Program of Revenue Enhancements	Unaccounted-For Water Reduction		Potentially AID Fundable	
	WAJ Action Plan	Total Cost - JD	Estimated Hardware/ Training Component	Plus 10% contingency
	Meter underregistration	1,115,900	900,000	990,000
	Source meter defects	189,300	165,000	181,500
	Billing system errors	51,700	25,000	27,500
	Illegal Connections	8,700	—	—
	Leakage	987,800	800,000	880,000
	Totals	2,353,318		2,075,000
	US \$ @ 0.36 JD/\$ = 5,775,000			
	<u>Computer Model for Tariff Analysis</u>			
	4 mm @ \$14,000 = \$56,000; Transportation = 2,200, Living Allowance = 3,600			
	4 mm @ 4,000 = 16,000			
	Total Costs = 77,800			
	<u>Seed Funding for Sewer Connection Revolving Fund, Lump Sum</u> = 150,000			
	Total Potential Estimated Cost = \$6,002,800			
	Say = <u>\$6,000,000</u>			

APPENDIX D

Persons Contacted

APPENDIX D

Persons Contacted

WAJ Headquarters

Mr. Mutazz Belbeisi	Secretary General
Engr. Abdelrahman Omari	Director of Planning, Development, and Information
Engr. Bassam L. Al-Tal	Director, Planning and Development
Mr. Fawzi N. Abu Niaaj	Director, Organizational Development
Dr. Engr. Sager Salem Al-Salam	Director of Central Operations
Engr. Abed Ellatif Abu Keer	Director, Construction Supervision
Mr. Musteim Saket	Director, Maintenance and Workshops
Mr. Abdul Rachman Adwan	Financial Manager
Mr. Ahmed Abdul Aziz Saleh	Head, Foreign Loan Projects Accounting
Mr. Ibrahim Alkam	Financial Analyst
Mr. James Cassanos	Technical Advisor
Mr. Jerry Esmay	Technical Advisor

WAJ Consultants

Mr. John R. Sproat, Jr.	Project Manager, WWST Project
Ralph W. Leidholdt, P.E.	O&M Specialist, WWST Project
Bernard Danthon	Engineer, Water Loss Reduction, SOGREAH

JVA Headquarters

Dr. Muhamad Bani Hani	Secretary General
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Royal Scientific Society

Dr. Murad J. Bino	Director, Industrial Chemistry Department
Engr. Ibrahim Alheim	Water Project Manager
Engr. Faïd M. Al-Jaber	Environmental Pollution Studies

WAJ - Zarqa

Engr. Nashat Savaged	Liaison Engineer
Engr. Abdul Wahab Matar	Plant Manager, Khirbet Al Samra Wastewater Treatment Facility

WAJ - Irbid

Mr. Fayez Batanaineh	WAJ Manager, Irbid Governorate
Mr. Safwan Shaladi	Director, Subscribers Department
Mr. Yousef Hajjat	Projects Department
Engr. Mazen Abu Shaar	Superintendent, Wastewater Treatment Plant
Engr. Ibrahim Malkawi	Chemist
Engr. Munir Jarrar	Operations Engineer

WAJ - Zai Water Treatment Plant

Engr. Abu Halaweh Hussein	Chemical Engineer
Mr. Qutishat Ghalib	Laboratory Technician
Mr. Steven R. Warner, P.E.	Consultant, Control Systems

WAJ - Karak

Engr. Taofiq Habashneh	Site Engineer, Karak Projects
Engr. Fares Shweihat	Head, Customer Department
Engr. Jazzam Damen	Manager, Wastewater Treatment Plant
Engr. Aziz Sajdi	President, Consulting Engineering Center (C.E.C.)
Dr. Lutfi Hallak	Project Manager, CEC

WAJ - Tafila

Engr. Malek Al-Rawashdeh	Site Engineer
Engr. Yousef N. Abdalla	Project Manager, Arabtech Engineers
Nabil I. Haddadin, P.E.	Technical Director, Sinimmar Engineering and Contracting

WAJ - Aqaba

Engr. Tamal Reyati	Manager, Wastewater Collection and Treatment
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USAID Mission, Amman

Dr. Richard A. Johnson	Deputy Mission Director
Mr. Lyle A. Weiss	Director, Engineering, Energy and Environment
Engr. Aied S. Sweis	Project Engineer
Engr. Farid Salahi	Project Engineer

USAID Mission, Amman (continued)

Mr. James Dempsey	Senior Project Development Officer
Mr. Thomas Krackiewicz	Regional Economist
Mr. William McKinney	Program Officer
Mr. Nimalka Wijesooriya	Controller
Mr. Douglas Robertson	Regional Legal Advisor
Mr. Nasr Nasr	Training Officer